



U.S. Shorebird
Conservation Plan
**DRAFT NOT FOR
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U. S. Pacific Islands
Regional Shorebird
Conservation Plan



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U. S. Pacific Islands – Regional Overview/Executive Summary

The U.S. Pacific Islands Region (USPI) is often overlooked as an important region for shorebirds largely due to its isolation, vast geography, and small land base. However, the region supports a surprising number of birds and is important in maintenance of global shorebird populations. The USPI stretches 5,000 mi (9,265km) from east to west across the Pacific Ocean and 3,000 mi (5,559km) from north to south and includes: the Hawaiian Islands; Guam and the Northern Mariana Islands; Wake Island and Johnston Atoll; Baker and Howland islands (in the Phoenix Islands); Jarvis, Kingman Reef and Palmyra (in the Line Islands); and the islands of American Samoa.

The USPI are of primary importance for three species of Holarctic-Nearctic breeders: Bristle-thighed Curlew (*Numenius tahitiensis*), Pacific Golden-Plover (*Pluvialis fulva*), and Wandering Tattler (*Heteroscelus incanus*). The majority of these species' populations over winter in the Pacific Islands, several of which are critical to the maintenance of these birds. The USPI are of secondary importance for Ruddy Turnstone (*Arenaria interpres*). All of the above species are common in winter and widespread across the Pacific. Other species occur in lower numbers, but are regular winter visitors. These include Sanderling (*Calidris alba*), Black-bellied Plover (*Pluvialis squatarola*), Long-billed Dowitcher (*Limnodromus scolopaceus*), Dunlin (*Calidris alpina*), Pectoral Sandpiper (*Calidris melanotos*), Lesser Yellowlegs (*Tringa flavipes*), Sharp-tailed Sandpiper (*Calidris acuminata*), and Bar-tailed Godwit (*Limosa lapponica*). The Mariana Islands support several other Asian breeders including: Asiatic Whimbrel (*Numenius phaeopus variegatus*), Grey-tailed Tattler (*Heteroscelus brivipes*), Mongolian Plover (*Charadrius mongolus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), and Red-necked Stint (*Calidris ruficollis*).

The U. S. Pacific Islands are also home to one endemic shorebird, the endangered Hawaiian Stilt (*Himantopus mexicanus knudseni*). This plan also addresses another Pacific endemic species, the Tuamotu sandpiper (*Prosobonia cancellata*). This diminutive sandpiper, listed as endangered by the IUCN, was once widespread throughout the central Pacific, but has been extirpated from most of its former range. Although it does not currently occur on the islands covered by this plan, historically it did occur in the Line Islands and predator free islands of the USPI could be important to recovery efforts.

Modern threats to shorebirds in the region include: loss of habitat to urban, industrial, military, agricultural and recreational development; introduction of invasive, non-native plants (degradation of habitat) and non-native animals (e.g. predation, disease, competition); human disturbance; and, contaminants (e.g. sewage discharge, oil spills, nuclear testing, pesticides). Conservation of shorebird habitats in the USPI is a growing effort and essential for the protection of endangered and declining shorebird populations. Wetlands, beach strand, coastal forests, and mangrove habitats are particularly vulnerable on large Pacific islands due to increasing development pressures and already limited acreages. Modified habitats, such as pastures, urban grass parks, and golf courses provide habitat for golden-plovers across the Pacific Islands.

There is little published literature (except from Hawaii) on status, trends, and ecology of migratory shorebirds in this region. Basic concepts such as seasonal status, distribution and abundance, important migration stopover locations, and habitat requirements are poorly understood. In general, islands of the western Pacific support more Palearctic nesting species, whereas the Hawaiian Islands support more Nearctic species. South of the equator, species diversity declines and is more equally represented by Asian and North American nesting species.

Monitoring and research needs include: the development of protocols to assess population sizes, track population trends, and assess timing and abundance of birds at key wintering and migration stopover sites; assessment of habitat use and needs at wintering and migration areas; better understanding of the linkage between wintering, stopover and breeding areas; and, refinement of habitat restoration and management techniques to meet the needs of resident and migratory species.

Education and public outreach remains a critical component of this plan as most resources in the

U. S. Pacific Islands Shorebird Conservation Plan

islands are directed towards endemic or endangered species. Recognizing the importance of migratory species as a component of the region's avifauna, and expanding public understanding of the need to protect such species remains a primary challenge.

Nowhere else in the world have so many species gone extinct as in the USPI. All the endemic shorebirds and waterbirds are endangered and implementation of a shorebird plan must be coordinated with ongoing recovery efforts. The logistics of a coordinated effort across the Pacific is complex. Coordination must be undertaken within the political framework of each island group. Resource management agencies of the U.S., Territorial, Commonwealth, and state governments will need to work together with military, university and non-governmental organizations to successfully implement components of this plan. The USPI plan is closely linked to the Alaskan Shorebird Conservation Plan and coordinated activities will ensure mutually beneficial and complimentary efforts. On a larger scale, coordination at the international level will be key to the conservation of vulnerable species, both migratory and resident.

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U. S. Shorebird Conservation Plan - Overview (from Brown et al. 2001)

The U.S. Shorebird Conservation Plan is a partnership involving organizations throughout the United States committed to the conservation of shorebirds. The organizations and individuals working on the Plan have developed conservation goals for each region of the country, identified critical habitat conservation needs and key research needs, and proposed education and outreach programs to increase awareness of shorebirds and the threats they face. The shorebird partnership created during the development of the Plan will remain active and will work to improve and implement the Plan's recommendations.

Natural landscapes in the United States have been altered significantly, and the wetlands, shoreline habitats, and grasslands used by shorebirds have been particularly disturbed. For many shorebird species, existing information is insufficient to determine how these alterations have affected populations. Many shorebird species face significant threats from habitat loss, human disturbance, and from different forms of habitat degradation such as pollution, prey resource depletion, and increasing threats from predators. Despite ongoing conservation efforts, many shorebird populations are declining, in some cases at alarming rates. Because development pressure will continue, critical conservation actions must be identified, integrated management practices must be developed, and ongoing changes in habitat configuration, quality, and availability must be controlled. Focused conservation action is needed now to protect and restore necessary habitats and address other threats to prevent additional shorebird species from becoming threatened or endangered.

The Plan has three major goals at different scales. At a regional scale, the goal of the Plan is to ensure that adequate quantity and quality of habitat is identified and maintained to support the different shorebirds that breed in, winter in, and migrate through each region. At a national scale, the goal is to stabilize populations of all shorebird species known or suspected of being in decline due to limiting factors occurring within the U.S., while ensuring that common species are also protected from future threats. At a hemispheric scale, the goal is to restore and maintain the populations of all shorebird species in the Western Hemisphere through cooperative international efforts.

Three major working groups were formed at a national level. The research and monitoring group developed scientifically sound approaches for tracking populations of shorebirds, identified the critical research questions that must be answered to guide conservation efforts, and determined funding requirements to meet these needs. The habitat management group worked with the regional groups to assemble specific regional habitat management goals into a national program. The education and outreach group focused on development of materials for schools and public education programs to help build awareness of shorebirds and the risks facing them throughout the country, and identified areas where increased funding for education and outreach are needed.

Eleven regional groups were formed during the development of the Plan. The major focus of these groups was to determine which habitats needed to be protected and managed to meet the requirements of the shorebirds in each region. Each group set its own regional goals and objectives, and collected information about ongoing management efforts and how they can be improved. In addition, the regional groups provided input to the development of the research and monitoring programs, and helped identify education and outreach needs.

The loss of wetland habitat in the U.S. has motivated federal, state, and private agencies to increase conservation and management of wetlands to preserve the public values of these critical habitats.

Wetland management and restoration have developed rapidly in recent years, and the North American Waterfowl Management Plan has stimulated significant increases in funding for wetland conservation activities. There is growing recognition among land managers of the opportunity to integrate management practices beneficial to shorebirds and other waterbirds into current management practices focused predominantly on game species. This changing orientation reflects the rapidly growing number

of people who engage in bird watching, wildlife photography, and eco-tourism in addition to traditional activities such as fishing and hunting. This growing constituency brings substantial economic benefits to wetlands and waterfowl areas, and has broadened public support for wetland conservation. We need management practices to focus on entire landscapes, but this requires an unprecedented level of coordination among multiple partners. No single conservation initiative can be effective alone. Wetland conservation for wildlife across entire landscapes requires the coordination of multiple efforts. The Shorebird Conservation Plan represents a significant contribution to the development of landscape level wildlife conservation, and can contribute significantly to these larger goals as part of a broad partnership for wetland conservation.

The Shorebird Plan is designed to complement the existing landscape-scale conservation efforts of the North American Waterfowl Management Plan, Partners in Flight, and the North American Colonial Waterbird Conservation Plan. Each of these initiatives addresses different groups of birds, but all share many common conservation challenges. One major task is to integrate these efforts to ensure coordinated delivery of bird conservation on the ground in the form of specific habitat management, restoration, and protection programs. The newly developing North American Bird Conservation Initiative addresses conservation needs for all birds in North America, and the Shorebird Plan partnership will work closely with this initiative toward common goals.

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Modern threats to shorebirds in the region include: loss of habitat to urban, industrial, military, agricultural and recreational development; introduction of invasive, non-native plants (degradation of habitat) and non-native animals (e.g. predation, disease, competition); human disturbance; and,

contaminants (e.g. sewage discharge, oil spills, nuclear testing, pesticides). Conservation of shorebird habitats in the USPI is a growing effort and essential for the protection of endangered and declining shorebird populations. Wetlands, beach strand, coastal forests, and mangrove habitats are particularly vulnerable on large Pacific islands due to increasing development pressures and already limited acreages. Modified habitats, such as pastures, urban grass parks, and golf courses provide habitat for golden-plovers across the Pacific Islands.

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Description of Region

Oceania comprises the islands and archipelagos of the central and south Pacific. This plan covers only the Pacific islands under the jurisdiction of the United States (Fig.1). Spanning the North Pacific from the Hawaiian Islands in the east to the Commonwealth of the Northern Mariana Islands in the west, and into the South Pacific to the islands of American Samoa, this is a vast region. Included are the islands and islands groups of Hawaii; American Samoa; Guam and the Northern Marianas; Baker and Howland islands (in the Phoenix Islands); Jarvis, Kingman Reef and Palmyra (in the Line Islands); Wake Island and Johnston Atoll. A list of individual islands covered by this plan is provided in Appendix 1. With the possible exception of Hawai'i, our knowledge of shorebirds in this region is poor, and this plan draws heavily on unpublished information regarding the status and populations of shorebirds in the region. As a result many of the data presented herein are done so for the first time. For the purposes of this plan the USPI is divided into four sub-regions: Hawaiian Islands, Mariana Islands, American Samoa, and Central Pacific Islands. Shorebird habitats vary within each sub-region and are mostly dependent on the size and type of island and the history of human occupation. There are basically three types of islands in this region:

- I. Volcanic islands, rising from the seafloor, often with high elevations that intercept tropical

moisture to create a variety of habitats. The main islands of Hawai'i, and Samoa are examples of Type I islands.

- II. Low limestone islands, usually truncated volcanoes fringed with coral, forming isolated islands or atolls with several islets. These islands typically have limited habitat diversity, little fresh water, and several have productive lagoons. The northwestern or leeward Hawaiian Islands and the islands of the central Pacific subregion are examples of Type II islands.
- III. Raised limestone islands, ancient coral reefs pushed up above sea level by tectonic movements. These islands are generally flat; support numerous caves and few wetlands, mostly along coastal regions. Guam and the southern Mariana Islands are examples of Type III islands.

One common component of all island groups is that landmass, and thus suitable habitats for shorebirds, is limited. Over 99% of the land area in this region is located on the volcanic (Type I) islands. However, most islands in the region are coral, sandy quays, islets with lagoons, or atolls that remain uninhabited or nearly so. Human populations in the USPI are concentrated on Type I and III islands due to adequate land base, strategic position, and water availability. Many of the low islands (Type II) are uninhabited, though none have escaped human alterations.

Shorebird Habitats in the USPI

In the USPI, shorebirds utilize a variety of habitats, many of which differ from those frequented by continental populations. Four habitats are predominately used: estuarine, wetlands, grasslands, and beaches. Tidal flats, estuaries, exposed reefs, freshwater marshes, ephemeral wetlands, ephemeral playads, salt marshes, and aquaculture lands (taro, shrimp, and rice) are key shorebird habitats that support the highest diversity of species. In particular, grasslands are important for golden-plovers and include grazed pastures, lowland grasslands, golf courses, edges of runways, and urban parks. Beaches include coral and volcanic sands, and associated dune systems. Beaches provide important habitat for curlews, turnstones, Sanderlings, and to a lesser degree, golden-plovers. Unique to American Samoa and Palmyra are littoral forests that support a surprising number of plovers and tattlers. This latter habitat is more fully addressed in the American Samoa subregion discussion. Shorebirds have been documented utilizing mangrove forests, but to what degree still remains unclear.

Wetland and Estuarine habitats

The USPI wetlands (that support shorebirds) can be categorized into the following types (follows Polhemus et al. 1992). Photo examples of these habitat types are included at the end of this plan.

- 1) *Seasonal Lowland Wetlands & Ephemeral Playads* – Large basins that flood from winter rains and dry through evapotranspiration. They behave similarly to playads of the Intermountain West and exhibit alkali soils. Common in Hawai'i on Ni'ihau, Maui, Moloka'i, O'ahu. Critical habitat for Hawaiian Stilt and important for all migrant species.
- 2) *Seasonal Lowland Wetlands (Ephemeral Freshwater Marshes)* – Freshwater vegetated wetlands that flood during the winter rainy season and dry in summer (or after monsoon rains). They are common in coastal areas of the main Hawaiian Islands, American Samoa, and Guam. Used by stilts (Hawai'i only), to a lesser degree, golden-plovers, and turnstones.
- 3) *Lowland Freshwater Marshes* – Permanent freshwater wetlands characterized by emergent vegetation and permanent water. Many are badly degraded due to non-native, invasive plant species and altered hydrology. These wetlands occur primarily in coastal springs and river

valleys. Associated with high islands of Hawaiian Islands, Marianas and American Samoa. Kawainui Marsh and Punamano Pond, O'ahu are examples. If in a hemi-marsh state (50% interspersed of vegetation to open water) or more open, can be important for several species including Hawaiian Stilt, golden-plovers, and turnstones.

- 4) *Lowland Saline Marshes* – Saline wetlands dominated by emergent vegetation most characterized by pickleweed (*Batis maritima*) and various sedges. Examples include Kealia Pond, Kanaha Pond, Maui and Aguana Marsh, Guam. Saline marshes are among the most important habitat in the islands for migrant shorebirds and are critical for Hawaiian Stilt.
- 5) *Estuaries* – Nearshore waters in natural basins fed by water from perennial stream runoff. Characterized by brackish species of plants, pickleweeds and mangroves. Vegetated areas often higher in elevation and provide roost sites for migrant shorebirds. Associated mudflats are important shorebird habitat throughout USPI. Examples include Pearl Harbor, Kaneohe Bay, Hawai'i, Pago Pago Harbor, Nu'uila Pala, American Samoa, and coves on Guam. Most have been seriously degraded by development, contaminants and introduced plant species. Historically widely used by large numbers of migrant shorebirds and stilts, less so now due to habitat loss and degradation due to development and introduction of mangroves (Hawai'i only).
- 6) *Coastal Mudflats* – Exposed at low tide usually on older islands with river runoff that deposit silt. Examples include Moloka'i's south shore and O'ahu's SE shoreline. Golden-plovers, tattlers, Sanderling, and turnstones are common on these flats at low tide. Some stilt use.
- 7) *Artificial Freshwater Habitats* – Manmade basins not managed for waterbirds specifically. These provide perennial water and thus emergent vegetation similar to natural wetlands. Includes reservoirs, aquaculture (rice and Taro), mariculture (shrimp), and wastewater treatment ponds. All common shorebirds can be found on these wetlands in varying diversity and abundance. On some islands, these are only wetlands available.
- 8) *Closed Lagoons* – Saline ponds and or lakes of Pacific Atolls. Vary in depth of a few feet to several hundred. Shallow margins can support emergent vegetation and sandy beaches and prolific invertebrate blooms. Examples include Laysan Lake, Hawaiian Islands, Swains Lagoon, and Palmyra Lagoon. Margins are utilized by Bristle-thighed Curlew, and important for turnstones and tattlers. Lagoons open to the ocean provide little habitat for shorebirds, except for sandy margins.

Other wetlands, of less importance to shorebirds, include: upland marshes, upland bogs, riverine systems, lowland saline swamps, anchialine pools, and lacustrine ecosystems (lakes and ponds).

Upland Habitats

Upland habitats important for shorebirds in the USPI can be categorized into the following types (follows Wagner et al. 1990). Photo examples of these habitat types are included at the end of this plan.

1. *Coastal Dry Grasslands* – Found mostly in remote, low and eroded islands and atolls comprised of several species of bunch and rhizominous grasses, intermixed with sandy soils. Important for numerous species of wintering shorebirds, including turnstones and curlews.
2. *Lowland Mesic Grasslands* – Moderately wet pastures and grasslands, managed as pasture. Widespread throughout the Pacific Islands in association with ranching and other agricultural practices. Widely used by golden-plovers in winter.

3. *Montane Mesic/Wet Grasslands* – Wet to very wet (dominated by hydric species of emergents) found on high, windward sides of islands above 2,000 feet (610 m). Most common on Maui and Hawai'i. Important for golden-plovers and to lesser degree turnstones.
4. *Coastal Dry Herblands* – associated with leeward coastal habitats found on dune systems and associated uplands. Characterized by sparse shrubs mixed with grasses. Found predominately on larger islands with older, more eroded coastal plains. Examples include Kahuku Plain, O'ahu and Mo'omomi Dunes, Moloka'i. Important for golden-plovers and curlews wintering or migrating through the region. Many offshore islets (particularly off of O'ahu) are characterized by this habitat and provide important over-night roost sites for shorebirds.
5. *Urban Grasses and Parks* – Large grass parks, golf courses, school ball fields, cemeteries, military antenna fields, mowed grass strips of Pacific Island runways, and urban lawns. These lawns are all generally mowed and maintained short providing excellent foraging habitat for golden-plovers. During rainy periods, other species often forage or roost, including turnstones, tattlers, and Hawaiian Stilt.
6. *Beaches* – Coral beaches are typical of all atolls and small islets and more eroded shorelines of main islands. Sparsely vegetated and exposed to active surf action. Some beaches on younger islands are comprised of basalt sands (e.g. Island of Hawai'i). This is a widespread habitat that is important for Bristle-thighed Curlew and Ruddy Turnstones, as well as other species of shorebirds throughout the USPI.
7. *Littoral Forests* – Littoral forests are coastal habitats dominated by *Pandanus*, *Pisonia*, and *Barringtonia*. The dominant tree depends on the substrate and soils. The understory is relatively open and is a favored habitat for golden-plovers, tattlers, and turnstones. At one time a common habitat in the Pacific, but human alterations to the landscape has limited this forest type. Still present in small patches in American Samoa and Palmyra Atoll.

Occurrence Patterns and Regional Species Priorities

Sixty-eight species of shorebirds have been recorded in the U. S. Pacific Islands (Appendix 2). Most occur as vagrants or annually in very small numbers. However the region does support hemispherically significant populations of three migrants (Pacific Golden-Plover, Bristle-thighed Curlew, and Wandering Tattler) and relatively large populations of an additional species (Ruddy Turnstone). The Hawaiian Stilt is the only shorebird that currently breeds in the region. Table 1 summarizes and ranks those species where their status is of primary importance, importance, and secondary importance status (follows Brown et al 2001). Tuamotu Sandpiper has not been documented from the USPI, but the type specimen was collected on Kirimati Island in the Line Islands (BirdLife International 2000).

The specific breeding origin of winter shorebirds in each of the islands groups is largely unknown for most species and most island groups. However, banding and recent radio telemetry and morphometric studies have helped to elucidate breeding origins of plovers, turnstones, and curlews that over winter in the USPI (Johnson and Connors 1996, Marks et al. in press, Gill et al. in press, Ely and Clapp 1973, Woodward 1972). Although most of the regional shorebird plans can calculate their region's importance based on North American population estimates, this does not portray an accurate assessment of wintering shorebirds in the Pacific islands since many birds breeding in Asia, spend their winter in the USPI.

Table 1. Prioritization Scores – Shorebirds of the U. S. Pacific Islands.

| <i>Species</i> | <i>PT</i> | <i>RA</i> | <i>TB</i> | <i>TN</i> | <i>BD</i> | <i>ND</i> | <i>Area of Importance</i> | <i>Conservation Category</i> |
|-------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|---------------------------|------------------------------|
| Pacific Golden-Plover | U (3) | 5 | 2 | 2 | 5 | 4 | 5 | 4 |
| Hawaiian Stilt | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Bristle-thighed Curlew | U (3) | 5 | 2 | 4 | 5 | 3 | 5 | 4 |
| Wandering Tattler | U (3) | 5 | 2 | 2 | 3 | 2 | 4 | 3 |
| Ruddy Turnstone | 4 | 3 | 2 | 4 | 2 | 2 | 3 | 4 |

Ranking Criteria follows the U. S. Shorebird Conservation Plan (Brown et al 2001). (PT = Population trend, RA = Relative abundance, TB = Threats during breeding season, TN = Threats during non-breeding season, BD = Breeding distribution, ND = Non-breeding distribution).

Importance of the Region to Asian Nesting Shorebirds

A unique aspect to this regional plan is the abundance of over-wintering and migrant Asian shorebirds, particularly in the Western Pacific. As a result, understanding species assemblages and drafting a plan that is exclusive to North American shorebirds is impractical. Fortunately, the genera involved, also occur on both continents and habitat requirements are similar. The habitat, research, and monitoring goals of this plan will have wide reaching influences on shorebirds of the Holarctic. Another consideration is that we have little knowledge of the winter distribution of Holarctic breeders and their distribution in the islands. Are the Ruddy Turnstones or golden-plovers wintering in the Marianas from one or both continents? Are Sanderlings that over-winter in Hawai'i of North American origin? Where do the Sharp-tailed Sandpipers, that pass through Hawai'i, over-winter? These types of questions remain unanswered.

Shorebirds of Primary Concern in the U. S. Pacific Islands.

Bristle-thighed Curlew (*Numenius tahitiensis*)



Photo: Courtesy of M. Danzenbaker

Pacific Golden-Plover (*Pluvialis fulva*)



Photo: Courtesy of P. LaTourrette

Hawaiian Stilt (*Himantopus mexicanus knudseni*)



Photo: Courtesy of U. S. Fish and Wildlife Service

Wandering Tattler (*Heteroscelus incanus*)



Photo: Courtesy of P. LaTourrette

Species of Primary Importance in the Region

Hawaiian Stilt: The Hawaiian Stilt (*Himantopus mexicanus knudseni*) is endemic to the main Hawaiian Islands, breeding on Ni`ihau, Kaua`i, O`ahu, Moloka`i, Lana`i, Maui, and Hawai`i. It is the only breeding shorebird in the USPI and is of primary importance. Estimates based on biannual waterbird surveys reveal that the known population fluctuates between 1,200 and 1,600 birds (Engilis and Pratt 1993, Reed and Oring 1993, Reed et al. 1994). Although this population has been stable for several decades, it remains at very low levels. The Hawaiian Stilt is currently listed as endangered by federal and state endangered species acts. Populations are limited by declining habitat, poor quality of existing sites, and predation by introduced mammals. Large coastal wetlands and ephemeral playas are critical habitat for this species (USFWS 1999, Ducks Unlimited 1998). Recovery objectives are to maintain a stable population above 2,000 birds for 10 years and to have viable breeding populations on Kaua`i, O`ahu, Moloka`i, Maui, and Hawai`i. The Hawaiian Stilt is part of a superspecies complex that includes Black-necked (*H. mexicanus*), Black-winged (*H. himantopus*), White-headed (*H. leucocephalus*), Black-backed (*H. melanurus*), and Black (*H. novaezelandiae*) stilts. Recent genetic evidence suggests that it is most closely related to North American Black-necked Stilt (*H. m. mexicanus*) (Fleischer and Macintosh 2001).

Pacific Golden-Plover: The Pacific Golden-Plover (*Pluvialis fulva*) breeds in western Alaska and Siberia and is of primary importance because of its extensive wintering population throughout the Pacific Islands. Other wintering areas include: small numbers along the southern Pacific coast of the U. S. and the coasts of Southeast Asia, India, New Zealand, Australia, and northern Africa (Hayman et al. 1986, Johnson and Connors 1996). The Pacific Golden-Plover is the most abundant and ubiquitous species in the region. The Alaskan breeding population (approximately 16,000 birds [Morrison et al. 2001]) winters in the Hawaiian Islands, Marshall Islands and some as far south as Victoria, Australia (Johnson and Connors 1996). The Hawaiian Islands may also support birds breeding in Eastern Asia. Birds wintering in the Mariana Islands are assumed to breed in Siberia but the breeding origin of the American Samoa and Central Pacific birds is unclear. Turnover rates during migration is unstudied and radar studies depict larger movements of presumably plovers as they fly over Hawaii and Guam (Williams and Williams 1988, Johnson and Connors 1996).

Few attempts have been made to estimate the total wintering population in the region, even in Hawai`i where this species has received considerable attention. In Hawai`i, a conservative estimate ranges from 15,000 - 20,000 birds in the chain. This estimate is based on Christmas bird counts (year 2000), and pastoral surveys on Maui and Hawai`i, extrapolated to suitable land base (A. Engilis and K. A. Uyehara unpub data). Past estimates of 74,000 birds on the main Hawaiian Islands (Schwartz and Schwartz 1949) and 15,173 on the island of O`ahu (Giffin and Medeiros upubl data) have been reported. Approximately 1,900 birds have been estimated to winter on O`ahu golf courses alone (Johnson and Johnson 1993). Even at the lower estimate of 15,000 – 20,000 golden-plovers, Hawai`i supports a significant proportion of the Alaskan breeding population (Johnson and Connors 1996). Amerson, Jr. et al. (1982) estimated 4,500 golden-plovers on American Samoa. Stinson et al. (1997b) estimates 5,000 – 20,000 birds in the Marianas, with only a few thousand over wintering. Scattered populations occur throughout the remainder of the region.

Pacific Golden-Plovers are widespread across the region in any open habitat from beach strands to upland, open bogs. They prefer the large expanses of grasslands managed for grazing, residential, or even ornamental purposes, particularly on larger islands groups. They are common on golf courses, parks, cemeteries, lawns and grazed pastures. They are in good numbers on remote islands and atolls. The species supported a sport-hunting program in the Hawaiian Islands from before the turn of the 19th Century until hunting was stopped in 1941 (Schwartz and Schwartz 1949). We are unaware if plovers are hunted in other regions of the USPI.

Bristle-thighed Curlew: The Bristle-thighed Curlew (*Numenius tahitiensis*) is the only migratory species whose entire wintering population is restricted to the islands of the Pacific (Hayman et al. 1986; Marks et al. 1990). The northwestern Hawaiian Islands support an estimated 800 birds or 8% of the reported 10,000 – total population estimate (Brown et al. 2001; Morrison et al. 2001). Micronesia (not entirely surveyed) supports another 1,200 birds (Marks and Redmond 1994). Further south the Tuamotu Islands are suspected to support the remaining bulk of the birds, with a few birds in the Cooks and Marqueses islands (Marks and Redmond 1994, Marks et al. in press) and low hundreds at Palmyra (B. Flint, USFWS, pers. comm.). In Micronesia, it is widespread in the Marshall Islands but is accidental in the Eastern Caroline Islands and Mariana Islands. However, it is believed that many records of Bristle-thighed Curlew from the Marianas probably represent misidentified Whimbrels (*Numenius phaeopus*). On the wintering grounds, maintenance of habitat, and eradication, or control of alien mammals, are essential actions required to protect this globally rare species. In addition, monitoring is needed to ensure mammals do not become established on remote islands used by curlews. This species is especially susceptible to human disturbance, and their molt-induced flightlessness on the wintering grounds (unique in shorebirds) makes them especially vulnerable to mammalian predators (Marks and Redmond 1994). Up to 50% of the population is flightless during prebasic molt (Marks et al. 1990). This species is ranked Vulnerable by the IUCN (BirdLife International 2000) and the South Pacific Regional Environmental Programme (SPREP) highlights this species as a globally threatened species in need of regional action (Sherley 2001). Work in the USPI should be coordinated with efforts throughout Oceania.

Tuamotu Sandpiper: The lone survivor of an endemic genus of shorebirds (related to Holarctic tattlers), Tuamotu Sandpiper (*Prosobonia cancellata*) is among the world's rarest birds. The total population size is unknown, and the bird is restricted to a few atolls of the Tuamotu Islands (Hayman et al. 1986). Although currently outside the scope of this plan, this species is mentioned herein because of its once wide historical range, including a population (extirpated) on Kiritimati in the Line Islands. This species was never recorded from Jarvis or Palmyra (also in the Line Islands) but strategies for its recovery include the identification of suitable, predator-free islands for translocation (BirdLife International 2000). The U. S. Fish and Wildlife Service (USFWS) has been very active over the past two decades removing introduced predators from isolated islands under its management and recently eradicated mammalian predators from Jarvis Island and is currently working at Palmyra Atoll. The U. S. should work with SPREP and other international organizations to support research into the ecology and habitat requirements of this species and to include USPI in the evaluation of suitable translocation islands.

Species of Importance in the Region

Wandering Tattler: The Wandering Tattler (*Heteroscelus incanus*) is nowhere common but is ubiquitous to the USPI. The global population is estimated at 10,000 – 25,000 birds (Gill et al. in press) and the main non-breeding area is south-central Oceania from Hawaii south to Northern Australia (Gill et al. in press). However, there are few estimates of populations in the Pacific Islands. In 2000, Hawai'i Christmas Bird Counts yielded 163 birds in just a portion of the habitat and it is estimated that the Hawaiian Islands winter 1,000+ birds (A. Engilis pers comm). An estimated 900 birds winter in American Samoa (Amerson, Jr. et al. 1982). Combined these two island groups account for 8% – 19% of the wintering population. It is a regular component of the avifauna in the Central Pacific Islands and is uncommon in the Mariana Islands, being replaced in the western Pacific by the Gray-tailed Tattler (*H. brevipes*) (Stinson et al. 1997b). The Wandering Tattler, on their wintering grounds in the Pacific, uses a broader array of habitats than on coastal North America. It is found on rock coasts, exposed reefs, sandy beaches, and mudflats (Gill et al. in press).

Species of Secondary Importance in Region

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Ruddy Turnstone: The Ruddy Turnstone (*Arenaria interpres*) is a common shorebird throughout the Pacific Islands, yet its wintering numbers are small relative to other wintering regions of the world. Remote, sandy islands appear to support the largest numbers. In Hawai'i, the Leeward Chain winters large numbers relative to the size of the islands. In 2000, eleven Hawai'i Christmas Counts, yielded 3,795 turnstones, 2,936 of these were on Laysan Island (Table 2). It is listed as common in Hawai'i, and abundant to common in the Marianas (Pyle 1997, Pyle and Engbring 1985). Amerson, Jr. et al. (1982) estimated 550 birds wintering in American Samoa. Stinson et al. (1997b) estimates only several hundred birds wintering in the Mariana Islands, and Amerson, Jr. et al. (1982) estimated 550 birds in American Samoa. There are no estimates for other island groups. As with tattlers, Ruddy Turnstones use a variety of habitats while on their Pacific island wintering grounds, including sandy and rocky beaches, coral reefs, and mudflats. It is relatively common in pastures up to 7,000 ft (2,100 m) on Maui and Hawai'i (A. Engilis Jr. pers obs.). There have been numerous banding recoveries from the Hawaiian Islands and Johnston Atoll. They show a high percentage of birds wintering in this region of the Pacific originate from staging areas in the Pribilof Islands, Alaska (Table 3).

Table 2. Shorebird counts from year 2000 Hawai'i Christmas Counts (Source: NAS 2000, 2001).

| Count | Pacific Golden- Plover | Sanderling | Ruddy Turnstone | Wandering Tattler | TOTALS |
|-------------|------------------------------|------------|--------------------|----------------------|--------|
| HIHO | 894 | 40 | 256 | 24 | 1214 |
| HINK | 25 | 29 | 59 | 19 | 132 |
| HIPU | 32 | 0 | 0 | 1 | 33 |
| HIHA | 218 | 129 | 174 | 13 | 534 |
| HIKU | 127 | 10 | 23 | 6 | 166 |
| HIWO | 227 | 16 | 36 | 17 | 296 |
| HIWA | 89 | 5 | 9 | 4 | 107 |
| HIKA | 50 | 0 | 0 | 2 | 52 |
| Tern Island | 65 | 3 | 286 | 3 | 357 |
| Laysan | 1033 | 6 | 2936 | 110 | 4085 |
| Midway | 894 | 40 | 256 | 24 | 1214 |
| TOTAL | 3654 | 278 | 4035 | 223 | 8190 |

Species of Limited Importance in the Region

Seven species of North American breeding shorebirds were ranked with limited importance because their numbers are very small relative to other regions in North America (or Asia). However, these species are annual migrants to the USPI, in very small numbers, and part of the region's avifaunal diversity.

The Sanderling (*Calidris alba*) is widespread and locally common throughout the Pacific Islands. In total numbers, Sanderling is more numerous than tattlers and curlews, but in comparison to other wintering populations throughout the globe, the USPI supports a very small number of birds. Sharp-tailed Sandpiper (*Calidris acuminata*) and Bar-tailed Godwit (*Limosa lapponica*) are found in small numbers across the Pacific Islands, and are regular fall migrants as they pass through to the Southern Hemisphere (Pyle 1997, Stinson et al. 1997b). In Hawai'i, Sharp-tailed Sandpiper numbers have exceed 100 birds on occasion on coastal wetlands (e.g. Kealia Pond, Maui) (SIGHTAL). Black-bellied Plover (*Phuvialis squatarola*), Semipalmated Plover (*Charadrius semipalmatus*), Dunlin (*Calidris alpina*), Least Sandpiper (*Calidris minutilla*), Lesser Yellowlegs (*Tringa flavipes*), and Long-billed Dowitcher

(*Limnodromus scolopaceus*) all occur annually, in Hawai'i, but in very small numbers. In the Mariana Islands, Whimbrel (*Numenius phaeopus varigatus*), Ruddy Turnstone, Wandering Tattler, and Grey-tailed Tattler are common to uncommon. Another four species, all Asian breeders, are regular in very small numbers in the Marianas (10 – 50 birds per year): Mongolian Plover (*Charadrius mongolus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), and Red-necked Stint (*Calidris ruficollis*), they are accidental elsewhere in the USPI.

Migration Routes

The migratory paths taken by shorebirds to the Pacific Islands is poorly known, but the long over-water flights that are made are among the most spectacular of any migratory species. Three flyways have been postulated and are supported by banding studies (Johnson and Connors 1996, Marks and Redmond 1994, Kuroda 1961). Baker (1953) summarizes these flyways that include: Asiatic – Palauan Flyway (birds move from Asia to Western Pacific and Philippine Sea Islands), Japanese – Marianan Flyway (mostly Asian birds moving through Japan into the Mariana Islands and Caroline Islands), Nearctic – Hawaiian Flyway (birds breeding in Alaska and Eastern Siberia [Beringia] move through Hawai'i to Marshalls and Polynesia) (Fig. 2).

Although banding information is scant, there are patterns of distribution and species assemblages that support these flyways. Primarily Beringian and Nearctic breeding shorebirds visit the Hawaiian Islands. Few Palearctic species reach the Hawaiian Islands. Numerous banding recoveries of turnstones in the Hawaiian Islands confirm the Nearctic - Hawaiian Islands routes (Table 3). In addition, banded Wandering Tattlers from Alaska have been recorded in Hawai'i (Gill et al. in press, T. K. Pratt, USGS, pers comm.) and Pacific Golden-Plovers banded in Hawai'i have been recovered in the Copper River Delta of Alaska (Johnson and Connors 1996).

As one moves west across the Pacific, Nearctic species start to dwindle. The distribution of Bristle-thighed Curlew is a prime example of this pattern. Its winter distribution is predominately in the islands of Hawai'i, Central Pacific, Polynesia and west to the Marshall Islands (Marks et al. in press). They are absent from the Carolines and Marianas. Gray-tailed Tattler becomes more abundant and Wandering Tattler less abundant in the western Pacific. The former species is an Asian breeder using the Asiatic – Palauan Flyway. Rare species, occurring annually, in Hawai'i are represented mostly by North American species whereas those in the Marianas are represented by Asian forms. Appendix 2 breaks-down the species composition for each of the island groups of the Pacific.

Table 3. Ruddy Turnstone banding recoveries from NWHI.

| # Birds Banded | Date Banded | Location Banded | Date Recovered | Location Recovered | Notes |
|----------------|-------------|------------------------------|----------------|---|--|
| 1 | 23 Aug 1965 | St. George Is. Pribilofs, AK | 31 Aug 1965 | Whale-Skate Island, French Frigate Shoals | Recapt. on St. George Is. on 27 Aug 1965 |
| 1 | 1 Aug 1965 | St. George Is. Pribilofs, AK | 2 Sep 1965 | Tern Island, French Frigate Shoals | |
| 1 | 29 Jul 1966 | St. George Is. Pribilofs, AK | 19 Aug 1966 | East Island, French Frigate Shoals | |
| 1 | 2 Aug 1966 | St. George Is. Pribilofs, AK | 29 Aug 1966 | East Island, French Frigate Shoals | |
| 1 | 11 Aug 1966 | St. George Is. Pribilofs, AK | 26 Aug 1966 | Tern Island, French Frigate Shoals | |
| 2 | 12 Aug 1966 | St. George Is. | 12 Sep 1966 | East Island, French | |
| | | | | | |

| | | | | | |
|----|-------------|---------------------------------|----------------------|---|----------------------------|
| 1 | 18 Aug 1966 | Pribilofs, AK St. George Is. | 14 Sep 1966 | Frigate Shoals Tern Island, French | |
| 1 | Nov 1964 | Pribilofs, AK Kure Atoll | Aug 1967 | Frigate Shoals St. George, Pribilof Islands, Alaska | coll Kure on 9 Jan 1969 |
| 4 | Aug 1966 | St. George Is. Pribilofs, AK | later in 1966 | Kure Atoll | |
| 3 | 6 Sep 1967 | St. George Is. Pribilofs, AK | 3, 9, 17 Aug 1967 | Laysan Island | |
| 3 | Unknown | St. George Is. Pribilofs, AK | Unknown | Laysan Island | |
| 1 | 17 Sep 1964 | Laysan Island | 18 Aug 1967 | St. George Is. Pribilofs, AK | |
| 2 | 1966 | St. George Is. Pribilofs, AK | | Johnston Atoll | |
| 1 | 19 Oct 1964 | Sand Island, Midway | 14 Aug 1966 | St. George Is. Pribilofs, AK | |
| 17 | fall 1966 | St. George Is. Pribilofs, AK | 16-30 Sep 1966 | Johnston Atoll | out of 387 sighted |
| 4 | fall 1966 | St. George Is. Pribilofs, AK | 1-15 Oct 1966 | Johnston Atoll | out of 410 sighted |
| 21 | fall 1966 | St. George Is. Pribilofs, AK | 16-31 Oct 1966 | Johnston Atoll | out of 401 sighted |
| 17 | fall 1966 | St. George Is. Pribilofs, AK | 1-15 Nov 1966 | Johnston Atoll | out of 396 sighted |

Sources: Amerson, Jr. 1971, Woodward 1972, Ely and Clapp 1973, Amerson, Jr. and Shelton 1976

Conservation Priorities for the U. S. Pacific Islands

Summarized below are the highest and shared priorities for the USPI as a region. These priorities and those unique to each island group are further detailed in the subregion sections that follow.

Species Objectives

- ⇒ Obtain accurate estimates of wintering and transient populations of shorebirds
- ⇒ Set population objectives for each subregion for Pacific Golden-Plover, Bristle-thighed Curlew, and Wandering Tattler
- ⇒ Increase the populations of Hawaiian Stilt to 2,000 birds, and maintain for ten years (delisting criteria USFWS 1999)
- ⇒ Assure multiple breeding colonies of Hawaiian Stilt on several main islands (delisting criteria USFWS 1999)
- ⇒ Determine trends in populations of primary importance, importance, and secondary importance categories
- ⇒ Work with global partners to evaluate the potential for reestablishing Tuamotu Sandpiper within their historic range, for example the Line Islands

Monitoring

- ⇒ Maintain monitoring of endangered Hawaiian Stilt and examine trends to support recovery goals

- ⇒ Develop standardized, statistically rigorous, GIS based protocols to monitor population size and trends of USPI shorebirds with emphasis on Pacific Golden-Plover, Bristle-thighed Curlew, and Wandering Tattler. This will assist in establishing population level objectives for the USPI.
- ⇒ Coordinate monitoring activities with the Program for Regional and International Shorebird Monitoring (PRISM)
- ⇒ Monitor for introductions and spread of introduced mammals and snakes. Prepare plans to minimize the potential for such “predator spills” and outline actions so that introductions can be eliminated immediately. Focus on cats, mongoose, rats, and tree snakes, but do not exclude others that might pose threats
- ⇒ Monitor response of shorebirds to predator removal programs in the USPI
- ⇒ Monitor islands for oil spills, contaminants issues, human generated waste and debris on remote beaches

Research

- ⇒ Develop a balanced approach to managing wetlands to benefit shorebirds, endangered waterbirds, and other migrant and resident waterbirds
- ⇒ Coordinate with the international community (SPREP) to document habitat requirements for Tuamotu sandpipers and evaluate the suitability of USPI for supporting translocated populations
- ⇒ Investigate the effects of pesticides applied to golf courses on Pacific Golden-Plovers.
- ⇒ Determine the breeding origins, migration routes, and key wintering/migration stopover sites for Pacific Island migrant curlews, golden-plovers, and tattlers
- ⇒ Document habitat requirements for priority species
- ⇒ Assess limiting and ecological factors in lagoon systems in relation to wintering shorebird needs
- ⇒ Investigate the control of invasive plants and develop eradication methods for key species threatening shorebird habitats

Management

- ⇒ Restore habitats where needed, focus on estuarine habitats and wetlands in all islands, beaches and uplands where suitable, and lagoons in remote island groups
- ⇒ Develop best management practices for wetlands and grasslands under agency and private ownership
- ⇒ Assess the use of easements to protect and enhance shorebird habitats on private lands
- ⇒ Seek to create suitable habitats, e.g. wetlands, in order to diversify island resources for migrant and resident shorebirds
- ⇒ Protect important upland habitats for Pacific Golden-Plover
- ⇒ Protect important habitats for Bristle-thighed Curlew
- ⇒ Eradicate or control introduced species that degrade wetland habitats
- ⇒ Eradicate or control introduced predators at important shorebird sites
- ⇒ Seek RAMSAR designation for key wetland habitats in the USPI, particularly in the Hawaiian Islands where sites have not been identified (e. g. Kealia Pond, Maui)

Outreach and Education

- ⇒ Increase public awareness of the process of migration, shorebirds as part of island biota, and protection of habitats for migrant shorebirds
- ⇒ Coordinate actions through Education Departments, non-profit groups, and community based activities
- ⇒ Create education packets for priority shorebird species and integrate the USPI shorebird community into the Sister Shorebird Schools Program
- ⇒ Investigate the feasibility of involving the public and school children into monitoring programs for Pacific Golden-Plovers

Coordination

Key to successful implementation of this plan will be coordination at international, national and local scales. Federal agencies such as U. S. Fish and Wildlife Service (USFWS), Department of Defense (USDOD), U. S. Environmental Protection Agency (USEPA), National Park Service (NPS), and U. S. Geological Survey (USGS) need to coordinate with local equivalent agencies. Most of the shorebird species in the USPI are migratory species that breed in the arctic. It is important to coordinate conservation efforts with individuals and agencies working in other parts of the species range. In addition, coordination with agencies responsible with the recovery of endangered species (Guam, CNMI, Hawai'i) or rare species (American Samoa) must be considered so that mutually beneficial objectives of this and existing recovery plans can be achieved. Education and outreach will be undertaken at all levels including non-profit organizations and local departments of education. The Sister Shorebird Schools Program can play an important role in local, national and international outreach and education efforts. Key conservation groups working in the region include, The Nature Conservancy (TNC), Ducks Unlimited, Inc., (DU), and National Audubon Society (NAS), These groups could coordinate with agencies and local NGOs to help facilitate the implementation of this plan.

Aside from Hawaiian Stilt, all of the other shorebird species of concern are migratory and widespread throughout the Pacific, or reside in other regions of the Pacific (*Prosobonia*) and thus conservation actions must consider international efforts. The Asia-Pacific Migratory Waterbird Conservation Strategy and its Shorebird Working Group, and the recently formed Pacific Bird Conservation Working Group, South Pacific Regional Environmental Programme (SPREP), BirdLife International, Wetlands International, and the International Shorebird Network are examples of such efforts encompassing the Pacific Islands.

The U.S. Pacific Islands host many shorebirds that breed in Alaska. They serve as critical wintering habitat for three species of primary importance, the Bristle-thighed Curlew, Pacific Golden-Plover and Wandering Tattler. Each of these species are of concern due to either small population sizes or limited breeding distribution. For this reason, the Alaska and Pacific Islands Shorebird Conservation Plans should collaborate to foster cooperative conservation and research efforts between the two planning regions. Specific tasks include research, monitoring and identifying links between specific populations of shorebirds breeding in Alaska and wintering in the U.S. Pacific Islands. These two regions should work together to determine the best methods to monitor populations and habitats used throughout the annual cycle.

Hawaiian Islands Subregion

Description of Subregion – The Hawaiian Archipelago, spanning the tropical and subtropical portions of the North Pacific, consists of 132 islands, reefs, and shoals stretching 1,523 miles (2,452 km) from the Island of Hawai'i at Latitude 18° 54' N to Kure Atoll at 28° 15' N. There are eight, large volcanic islands, collectively called the Main Islands (Fig. 3, App. 1) and numerous associated rocks and islets. The Leeward, or Northwestern Hawaiian Islands, comprise nine small islands/atolls extending from Nihoa to Kure. The island of Hawai'i is the largest, most southerly, and youngest of the chain. Thus, as one proceeds northwest along the chain from Hawai'i, the islands become older. Ni'ihau, the oldest of the Main Islands, is privately owned.

The Main Islands lie completely within the tropics and comprise 99% of the landmass of the chain. Limited landmass, only 6,540 mi² (16,939 km²), translates to limited land base for shorebirds. Add to this the mountainous nature of the Main Islands, and wetlands and coastal strands become even more limited. There is a distinct wet (windward) and dry side (leeward) to each island. Windward coasts and slopes have rainfall areas that can exceed 400 inches (1,016 cm) per year, whereas leeward habitats can be quite arid with less than 10 inches (250 cm) per year.

As a result of this inequity of precipitation, most of Hawai'i's wetlands are located in river valleys and estuaries on the windward coasts of the Main Islands. There are exceptions. Pearl Harbor is located on O'ahu's south (dry) coast. In addition, basaltic islands possess perched freshwater lenses in the porous rock, resulting in coastal springs and groundwater wetlands, even on the dry, leeward shores. The USFWS (Dahl 1990) estimates a 31% decrease in the acres of coastal plain wetlands between 1780 and 1990, from 22,475 ac (9,095 ha) to 15,474 ac (6,262 ha). Approximately 70% of the remaining sites are overgrown with alien plants and have altered surface and ground hydrology (Shallenberger 1977). Many of Hawai'i's largest wetlands have been protected by state and federal agencies as sanctuaries and refuges, however, restoration and active management are a high priority and are specified in the Hawaiian waterbird recovery plan (USFWS 1999).

In contrast to the loss of wetlands, grassland habitats in the Main Islands have increased since human colonization. Much of this increase was at the expense of the native forests, which were cleared and converted to pastures and for human dwellings. Large ranches, especially on Hawai'i, provide extensive acreage of non-grazed and grazed grasslands. This acreage however has declined over the past thirty years due to shifts in land values and crop economics in a growing world economy (Table 4). The Island of Hawai'i accounts for over 55% of the total farm acreage, most of which is in pasture and Maui an additional 20%, most of which is in diversified agriculture (Morgan 1983, State of Hawai'i 1999).

Table 4. Farmland Acreage in the Hawaiian Islands (includes crops and pasture).

| <i>Year</i> | <i>Total State (Acres/Hectares x 1000)</i> | <i>Total Hawai'i Island (Acres/Hectares x 1000)</i> | <i>Total Maui (Acres/Hectares x 1000)</i> |
|------------------|--|---|---|
| 1970 | 2,300 (932) | 1,340 (543) | 526 (213) |
| 1980 | 1,970 (798) | 1,150 (466) | 420 (170) |
| 1988 | 1,720 (625) | 1,010 (412) | 290 (118) |
| 1998 | 1,440 (588) | 870 (355) | 290 (118) |
| % decline | 37% | 35% | 45% |

Source: Morgan 1983, State of Hawai'i 1999

Increasing human population has resulted in increased amounts of recreational grasslands in the form of parks, golf courses, cemeteries, and lawns. The majority of this habitat type is privately owned or owned by city, county or state and managed for uses other than wildlife.

The Leeward Hawaiian Islands are in stark contrast to the Main Islands. In general, they are highly eroded, low sand islands and atolls that support extensive coastal strands and reefs relative to their landmass. Nihoa and Necker (the youngest of the leewards) are small, steep rocky islands supporting only tiny sand beaches. Gardner Pinnacles and La Parouse Pinnacle (French Frigate Shoals) are also rocky outcroppings. Sandy beaches and bunchgrass dunes are the dominant habitat on the remaining Leeward Islands. These islands support a low diversity of plants, mostly herbaceous species and small shrubs and trees. By definition, the atolls (Kure, Midway Pearl and Hermes, and French Frigate Shoals) have fringing coral reefs and interior lagoons that are open to the ocean. Laysan Island has a closed lagoon (technically a lake) that is hypersaline, and the only natural wetland in the leewards. Historically Midway, Kure, Pearl and Hermes, and French Frigate Shoals were operated as military installations and consequently have been highly altered. All have runways and permanent buildings. Midway, with the longest history of human occupation, has well-developed, non-native *Casurina* forest. Midway Naval Air Station closed in 1996, and the Coast Guard Loran Stations on Kure and French Frigate Shoals were closed in 1991 and 1979 respectively. Today, all except Midway are uninhabited (apart from researchers) and all are protected as National Wildlife Refuges or State Wildlife Sanctuaries. Public access to all is strictly controlled by permit.

Shorebird Habitat Use

Wetlands, estuaries, tidal flats, grasslands and uplands are the most important habitats for migrant and resident shorebirds. Hawai'i's wetlands and tidal flats support the highest diversity and density of shorebirds in the islands. Grasslands and beaches are important for two priority species, Golden-Plover and Bristle-thighed Curlew respectively. Historical notes highlight the importance of tidal flats for migrant shorebirds (Perkins 1902, Munro 1945, Cogswell 1945). Tidal flats of Pearl Harbor were especially important through at least the late 1950s (R. L. Pyle pers. comm.). In 1945, surveys yielded over 1,600 shorebirds (Cogswell 1945, Table 5). Other tidal flats in the state, specifically Kaneohe Bay and Moloka'i's south shore were not systematically covered during the same time period.

Table 5. Summary of birds counted (mean) on Pearl Harbor Tidal Flats Sept – Dec 1945 (Cogswell 1945).

| Species | Mean Count |
|-----------------------|------------|
| Pacific Golden-Plover | 583 |
| Ruddy Turnstone | 585 |
| Wandering Tattler | 35 |
| Dowitcher sp. | 1 |
| Sanderling | 251 |
| Hawaiian Stilt | 163 |
| TOTAL | 1,618 |

During high tide, golden-plovers move inland, but readily move to tidal flats at low tide. Today, high numbers of golden-plovers can be found on O'ahu in Kewalo Basin, Pearl Harbor, the southeastern shore from Diamond Head to Koko Head, and on Moloka'i's south shore (SIGHTAL Database, HAS Christmas Counts, AEJR unpub data). Ephemeral playas and alkali wetlands also support large numbers of shorebirds, and are next in importance for diversity and abundance. Kealia Pond, when shallowly flooded in fall can support over 1,000 golden-plovers and 14 species of shorebirds (USFWS records). The small hypersaline lagoon on Laysan regularly supports over 4,000 shorebirds (Ely and Clapp 1973). Most other playas in the state have become overgrown with pickleweed and fleabane and are not used. Ni'ihau's playas seem critical but their importance is undocumented, due to the fact that they have not been surveyed from the ground since 1939. Complexes of wetlands, involving playas; seasonal,

semipermanent and permanent ponds; aquaculture; and cane waste ponds historically supported numerous birds; particularly on Oʻahu’s North Shore from Kahuku to Wailua (Fig. 4).

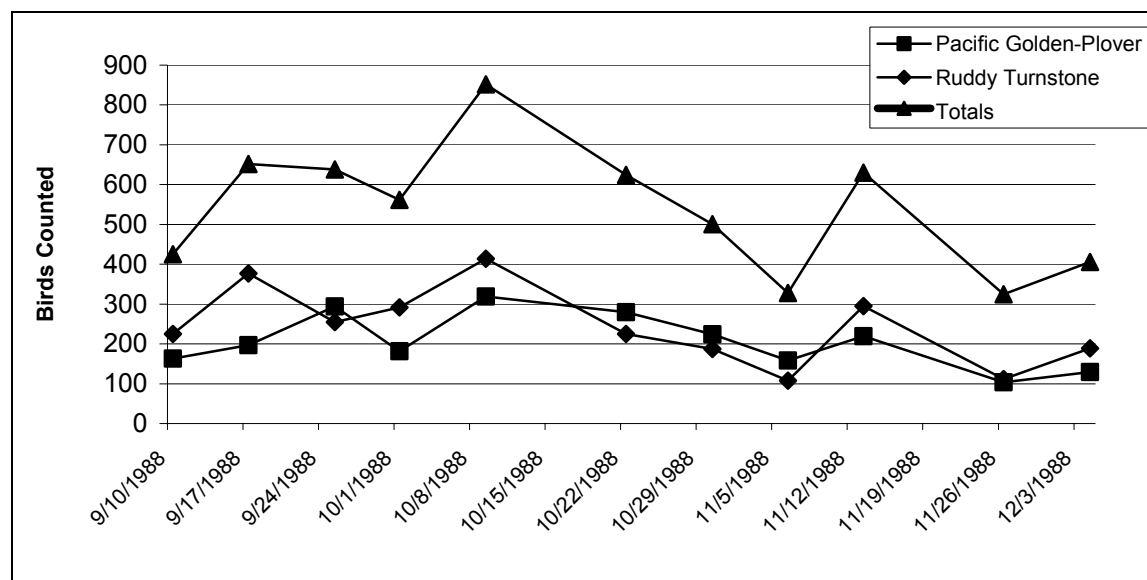


Figure 4. Shorebird Counts on wetland complexes of Oʻahu’s Kahuku Plain (Engilis 1988, unpubl. data).

Many water projects in the Main Islands have become important habitat for shorebirds and the scant data available is summarized for the first time in this plan. Indeed some of the highest concentrations of shorebirds can be seen at many of the state’s aquaculture farms. However, the endemic Hawaiian Stilt as well as migratory shorebirds, become dependent upon these man-managed sites and when economic pressures result in closure, the ponds are abandoned and allowed to dry. This pattern of dependence and loss of habitat has occurred numerous times in the past 15 years with the collapse of the sugar cane industry, resulting in the loss of reservoirs and wastewater ponds, and a fluctuating and heavily subsidized mariculture (shrimp) industry. Data from Hawaiʻi’s Kona Coast verifies this dependence on waste ponds and aquaculture (Fig. 5). Reservoirs are widely used by shorebirds, particularly when drawn down (Shallenberger 1977). Kauaʻi and Maui support the largest concentration of reservoirs, all of which are now being lost due to the collapse of the cane industry. Waipiʻo Peninsula in Pearl Harbor was used by the Oʻahu Sugar Company as a site for wastewater disposal of cane water. Several ponds were created that were managed to catch water and sludge. These ponds were the most popular sites in the state for bird watchers because of the high numbers of shorebirds (both diversity and density). Many state records for shorebirds were found on these ponds (Bishop Museum Sightings Database [SIGHTAL]). The ponds dwindled in numbers as production curtailed in the mid-1980s and then were lost entirely when the mill went under in the early 1990s. During that time shorebird numbers have declined (Fig. 6).

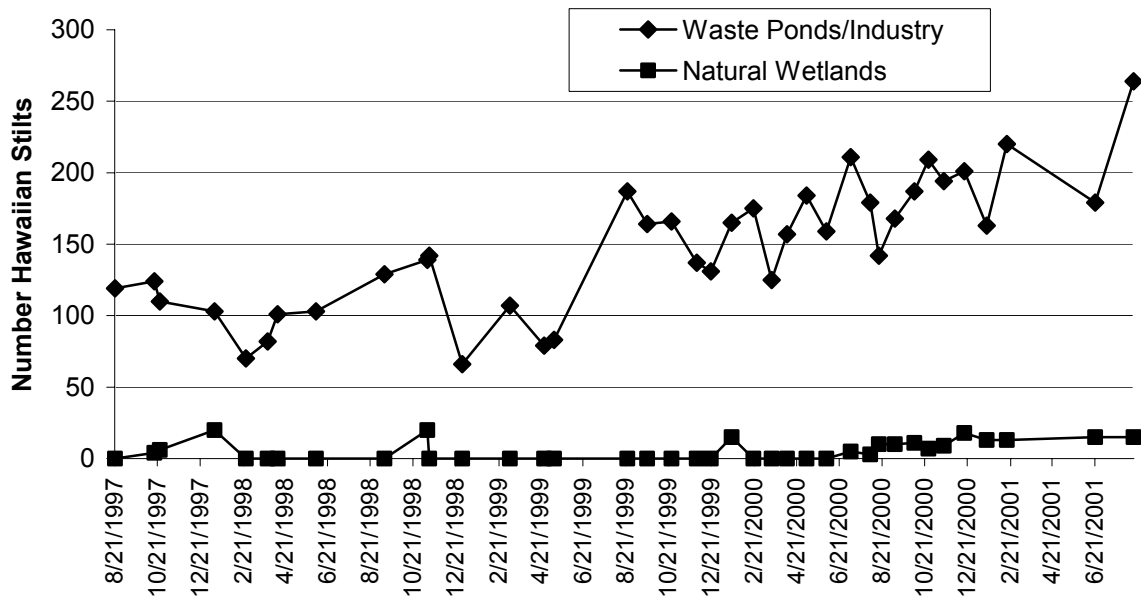


Figure 5. Hawaiian Stilts in aquaculture and waste ponds vs natural wetlands, Kona Coast, Hawai'i (Ducks Unlimited 2002)

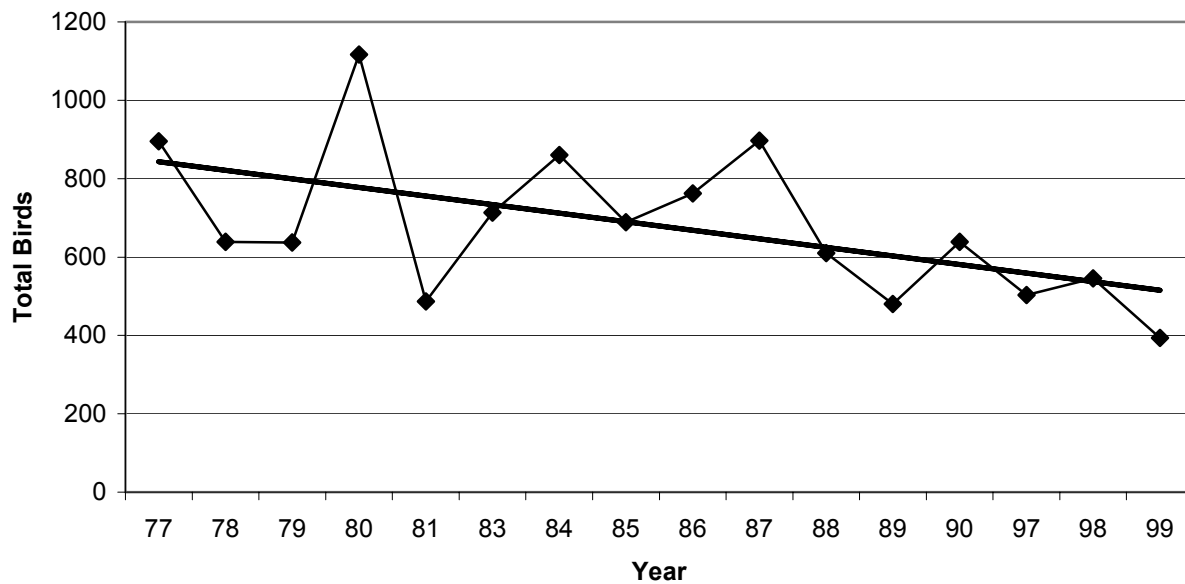


Figure 6. Shorebird decline since the collapse of the O'ahu Sugar Mill in early 1990s (Source: NAS 2000, 2001).

As with elsewhere in North America, wastewater treatment ponds attract large numbers of shorebirds. Normally these would not be mentioned in a plan of this nature, but with limited wetlands, their mere presence has altered bird use. One need only look at the small facility on Lana'i. Lana'i is a dry island and up until 1989 did not support native waterbirds. This changed with the opening of the Lana'i City

oxidation ponds. Pioneering Hawaiian Stilts quickly found this facility and are now nesting on Lanaʻi. Surveys of the ponds in 1999 yielded seven species of shorebirds in small numbers (A. Engilis pers obs.). As long as these managed ponds exist, they will be an important resource for Hawaiian Stilt and migratory shorebirds.

The Leeward Islands' beaches and bunch grasslands and sparse shrublands support a surprising number of shorebirds (Amerson, Jr. 1971, Woodward 1972, Ely and Clapp 1973). Ample food, seclusion from human disturbance, and predator free conditions are ideal for wintering species. Historically, beaches on the Main Islands no doubt would provide important shorebird habitat, and still do, to a limited degree. Unfortunately most of the Main Island's beaches are key components to the tourist industry and human disturbance is high. A few secluded or protected beaches do provide limited habitat for shorebirds (e.g. on Lanaʻi, Kauaʻi's Na Pali Coast, and Kaena and Kahuku points, Oʻahu).

The final habitat type used by shorebirds is grassland. These vary from urban parks and golf courses to large grazed pastures on the Island of Hawaiʻi. These habitats support a large number of golden-plovers, as well as a few turnstones, and Hawaiian Stilts (lowlands only). There are no data to quantify the importance of upland pastures, but field observations during the past decade indicate they are important for golden-plovers (A. Engilis and K. Ueyhara pers. obs.).

Northwestern Hawaiian Islands:

Laysan Lagoon (735 ac [300-ha]) is a closed system that undergoes seasonal fluctuations in both depth and salinity. Brine flies and shrimp are abundant and provide an excellent food source. The lagoon along with adjacent sandy beaches provides important habitat for Pacific Golden-Plover, Bristle-thighed Curlew, and Ruddy Turnstone. Numbers exceeding 5,000 shorebirds are regularly counted during winter months (USFWS unpubl. records, HAS 2000, 2001, Ely and Clapp 1973). Another closed system is located on Spit Island, Midway Atoll. Smaller numbers of turnstone, tattlers winter there (Engilis pers. obs.). An artificial water catchment on Midway Atoll also provides important wetland habitat for migrant shorebirds.

The most significant shorebird habitat in the Northwestern Hawaiian Islands is the secluded, uninhabited beaches and associated dry grasslands. The most extensive are on Kure, Midway, Pearl and Hermes, Lisianski, Laysan, and French Frigate Shoals. Fringe reefs also occur in association with the islands and support a few shorebirds, but are virtually unexplored and unsurveyed. The high counts of shorebirds on Christmas counts of Laysan and Midway show the importance of these islands (and habitats) for migratory shorebirds (Table 2). The extent to which shorebirds use habitats in the Northwestern Hawaiian may be an indicator as to historic importance of beaches and dunes across the island chain. These remote island habitats, particularly bunchgrass are critical for Bristle-thighed Curlew (especially when they are flightless during molt) (Marks et al. in press), but also support large numbers of Pacific Golden-Plover, Ruddy Turnstone, and Wandering Tattler, and Sanderling.

Niʻihau:

The ephemeral wetlands on Niʻihau, although virtually unknown, are among the most critical for migratory and endemic waterbirds and shorebirds in the Hawaiian Islands (Munro 1940, T. Telfer pers. comm.). There is some evidence that the production of Hawaiian Stilt in the ephemeral wetlands is critical to the maintenance of the entire world population (Engilis and Pratt 1993). Three playas, when flooded, provide 1,900 ac (770 ha) of shallow basins. These are privately owned (as is the entire island). Little is known about importance of the upland habitats and beaches on Niʻihau for shorebirds. Munro (1940) mentions Bristle-thighed Curlews present in November 1939 but did not directly associate them to habitat. Understanding the role of Niʻihau's habitats for shorebirds remains a high priority in the Hawaiian Islands for recovery of endangered waterbirds (Ducks Unlimited 1998, USFWS 1999).

Kaua`i:

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Kaua`i is the wettest of the Main Islands of the archipelago and supports the highest number of wetlands. Unfortunately many of the larger sites have been drained for agriculture. The 5,000-ac (2,024 ha) Mana Marsh was once the largest wetland in the islands but was drained in 1923 to make way for Sugar Cane. Other coastal wetlands on Kaua`i were altered due to extensive hydrologic changes (reservoirs for sugar cane and flood control). The remaining wetlands on Kaua`i are mostly overgrown with exotic vegetation and provide little habitat for shorebirds. Aquaculture is widespread and the extensive taro fields of the Hanalei River Valley and smaller fields in other valleys (Lumamai, Waimea, Hulei`a) support many shorebirds (Hawaiian Stilt, golden-plovers, turnstones, *Calidris* sandpipers), particularly in early successional stages. Kaua`i used to support several sugar cane effluent ponds, most of which have become recently inactive. These ponds, when active supported numerous shorebirds primarily turnstones, tattlers, golden-plovers, and Hawaiian Stilt (SIGTAL). The most common shorebird on Kaua`i is the Pacific Golden-Plover. It occurs in numerous habitats from coastal beaches up to the Alakai Swamp at 4,000 feet (1,219 m). There are no estuaries or playas of significance for shorebirds on Kaua`i. The U. S. Fish and Wildlife Service (USFWS) manages two refuges for waterbirds on Kaua`i (Hanalei and Hulei`a NWRs) and the state has two small reserves on the Mana Plain. A few Hawaiian Stilt breed at refuges and state wildlife areas when conditions are suitable.

Most of Kaua`i's uplands are forested and steep, harboring only remnant patches of open grasslands and some bogs. Although golden-plovers can occur in these, they represent a small fraction of birds on the island. Lowland grasslands are associated with agricultural fields. The collapse of the sugar cane industry in Kaua`i jeopardizes much of the remaining agricultural lands, which has decline in acreage nearly 30% since 1970 (Morgan 1983, State of Hawai`i 1999). Much is slated for urban development. In addition, pastures in some of the river valleys, e.g. Hanalei and Wailua rivers, support migrant shorebirds, if they are grazed. Kaua`i has extensive golf courses and small parks that support numerous golden-plovers, but few other shorebirds.

The more extensive beaches are for the most part developed and support few shorebirds.

O`ahu:

O`ahu is perhaps the most diverse island in the chain in regards to shorebird habitat with excellent tidal flats, estuaries, playas, ephemeral, permanent marshes, managed wetlands, and urban grasslands. However, many of the largest wetland and lowland sites have now been urbanized. Pearl Harbor, the largest estuary in the Pacific, is heavily developed and industrialized. The West Loch is least impacted portion of Pearl Harbor, but red mangroves (*Rhizophora mangle*), an invasive species, has overgrown most of the mudflats historically used by shorebirds. Prior to mangroves, West Loch was heavily used by migratory and shorebirds for foraging during low tide (Cogswell 1945, R. L. Pyle, pers. comm.). Other important tidal flats include Paiko Lagoon, Kaneohe Bay, Kewalo Basin, and the series of ponds at Nu`upia (Kaneohe Marine Corps Station Hawai`i). All are used by flocks of shorebirds for foraging at low tide, but mangroves have overgrown most flats and threaten others. On a brighter note, mangroves have been effectively removed and from Nu`upia Ponds with positive benefits to shorebirds (Drigot 2001).

Important to shorebirds are the freshwater, ephemeral and managed wetlands on the windward and north shores of O`ahu. Most are protected but exist in a degraded state (Kawainui Marsh, He`eia Marsh, Ka`ele`pulu Pond). Only the main complex of ponds of the James Campbell NWR, in Kahuku is widely used by shorebirds. Several playas exist on state land at Kahuku Point; most are overgrown by alien plants. One of Hawai`i's largest wetland complexes was Waikiki. It was drained in the early 1920s paving the way for the development of Honolulu. Another critical wetland drained in the 1950s was Ka`ele`pulu Wetland in the town of Kailua. The USFWS manages two refuges for waterbirds on O`ahu, James Campbell and Pearl Harbor NWRs. The state of Hawai`i manages four refuges, Hamakua,

Kawainui and He`eia marshes and Paiko Lagoon. The U.S. Marine Corps manages Nu`upia Pond, one of three critical sites for nesting Hawaiian Stilt (Drigot 2001).

O`ahu's historic shorebird habitats are, today, mostly urbanized, but part of this development has been the creation of extensive mowed grass parks, golf courses, and lawns that support a surprising number of golden-plovers (Johnson and Johnson 1993). In addition, urban O`ahu rooftops provide important roosts for golden-plovers (Johnson and Nakamura 1981). Grasslands associated with dunes (Kahuku and Kaena points) provide habitat for golden-plovers and Bristle-thighed Curlews. At times curlews have been observed on North Shore Golf Courses (SIGHTAL Database, A. Engilis, Jr. pers. obs.). Lowland grasslands are generally associated with agricultural fields, as fallow fields in crop rotation. The collapse of the sugar cane industry in Hawai`i jeopardizes many of the agricultural lands that are now slated for urban development. These cane lands provided open space buffers for wildlife areas, minimizing human disturbance to shorebirds and native waterbirds.

Some fringe coral are exposed at low tides (Paiko Lagoon and North Shore of O`ahu). Golden-plovers, turnstones, tattlers, and Hawaiian Stilts use these exposed reefs. O`ahu's windward shore is dotted with several small islets and exposed rocks. These are important as night roost sites for migrant shorebirds that forage on the main island during the day (Engilis pers obs). The offshore islets of O`ahu (e.g. Moku Manu, Manana) are protected as seabird sanctuaries by the state of Hawai`i.

Waikiki ca 1920 and 1990. One of Hawaii's largest wetland reclamation projects



Photo Courtesy Bishop Museum Photo Archives



Photo Courtesy A. J. McCafferty

Maui Nui:

Maui Nui comprises the four islands of Maui, Moloka`i, Lana`i, and Kaho`olawe. Kaho`olawe is the driest of the Main Islands, with the least topographic relief, but a small playa does exist in the center. This playa only fills in very wet periods, and remains unvegetated. Numerous shorebirds (particularly *Pluvialis* plovers) roost in the site (R. David pers. obs.). Lana`i is also a dry island and contains no natural wetlands. Maui is a relatively young island and consequently does not possess the diversity of wetlands seen on O`ahu, despite it being larger. The windward slope of Haleakala creates high rainfall regimes, but there are limited coastal flats to support wetlands. The main wetlands of Maui are located in the valley between Haleakala and West Maui. Kealia Pond, 740 ac (300ha), is the largest and one of the most important sites in the Pacific for migratory shorebirds. It is part of the Kealia Pond NWR and is a

prime example of a coastal alkali marsh. Modifications to the outlet by man have resulting in altered hydrologic features and Refuge staff must now initiate the draining of the pond. These draw downs remain a critical management action needed to initiate nesting by Hawaiian Stilt and provide critical foraging habitat for stilts and migrant shorebirds. In early fall when small amounts of water sheet across this unvegetated pond, thousands of shorebirds can be found comprising as many as 14 species (plovers, turnstones, stilt, tattlers, *Calidris* sandpipers, dowitchers) (M. Nishimoto, USFWS pers comm.). Nearly 50% of the Hawaiian Stilt population can be found on Kealia during this period (USFWS 1999). Numerous ephemeral basins occur in Kihei and along West Maui's southern shore, but most have been destroyed by development. Kanaha Pond, a deep-water habitat with some ephemeral habitat, is a state waterbird sanctuary surrounded by development on all sides. Despite this, the ephemeral basins are an important shorebird resource. Another minor pond, important for Hawaiian Stilt is Nu'u Pond on Haleakala's South east coast (USFWS 1999).

Most of Maui's beaches and dunes have been developed or degraded due to human alterations. Volcanic benches on Maui are exposed during low tides and are used by tattler, turnstone, golden-plover, and Hawaiian Stilt. Tattlers, turnstones, and Sanderlings sometimes use the beach fronting Kealia Pond. Maui's grasslands are diverse, ranging from immaculate golf courses to mid-altitude pasture, 3,000 feet (914 m) to 6,000 feet (1,829 m) up Haleakala's slopes. Golden-plovers commonly use these grasslands throughout the winter.

Moloka'i's shorebird habitats are located principally in wetlands and playas along the southern coast. Most have become degraded, but the Pala'au Flats comprise a 6-mile (11 km) long stretch of coastal wetlands that when flooded are some of the most diverse in the islands. Active restoration at several sites on the Pala'au Flats has provided excellent habitat for large numbers of shorebirds, including Hawaiian Stilt (Ducks Unlimited 1996). Pala'au Flats was recently identified as an overwintering site for Bristle-thighed Curlew (A. J. McCafferty and A. Engilis, Jr. pers obs). Numbers of shorebirds wintering on the Moloka'i's South Shore flats is already impressive, and with future restoration could rival other key sites in the Hawaiian Islands (Fig. 7). Freshwater wetlands are limited on Moloka'i and provide little habitat for migratory shorebirds. Mo'omomi Dunes are remote and support a few curlews and golden-plovers. Moloka'i has large stretches of undeveloped dunes and coastal flats, but their importance remains unquantified. Mangrove infestations along the south shore have jeopardized most of these coastal flats. Grasslands are uncommon but some agricultural fields support golden-plovers. There are few parks and golf courses, the latter are concentrated on Moloka'i's west shore. They provide for a minimal number of golden-plovers.

Lana'i has no natural wetlands, but the wastewater treatment ponds now support a small number of shorebirds. Parks of Lana'i City, golf courses, and fallow agricultural lands provide habitat for golden-plovers. Coastal beaches are frequented by only a few shorebirds.

Kaho'olawe is the driest of the Main Islands, however a small ephemeral playa exists that can support a surprising number of plovers when flooded (a rare event) (R.E. David pers. comm.). Open space and the few beaches of the island support only a few shorebirds. There is a potential for habitat restoration on Moloka'i, and introduced mammals are currently being eradicated. The latter action could prove important for wintering curlews.

Hawai'i:

The youngest of the Main Islands, Hawai'i's wetlands are associated with the perched groundwater lenses along the Kona Coast and to a lesser degree several smaller ponds along the windward Coast. A few small lagoons occur as well. Two of the most important wetlands 'Aimakapa and Opae'ula, are found on the Kona Coast. These two wetlands and several smaller intervening ponds provide the only natural habitat for nesting Hawaiian Stilts on the island of Hawai'i. Migratory shorebirds also use these wetlands. Windward shore wetlands are deeper and heavily overgrown with

emergent vegetation and provide limited habitat for shorebirds. The Kona Wastewater Treatment Plant and Cyanotech aquaculture facility are heavily used by stilts, golden-plovers, turnstones, tattlers, and *Calidris* sandpipers (Ducks Unlimited 2002).

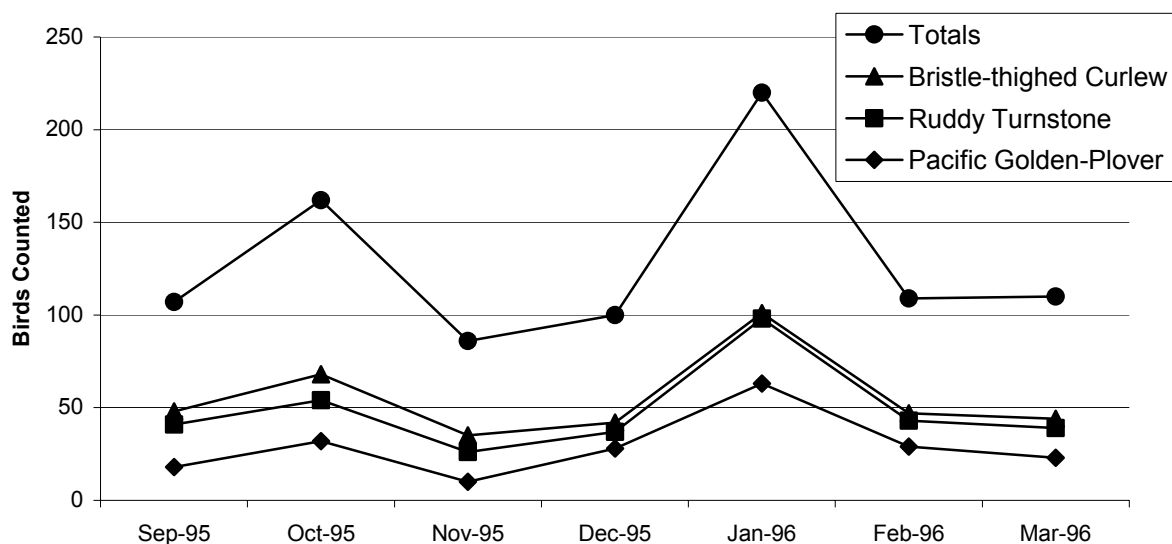


Figure 7. Shorebird Surveys of Moloka'i's South Coast, 1995 – 96 (Ducks Unlimited 1996)

Hawai'i has extensive tracts of short-grass pastures, the largest in the Pacific. These pastures are widely used by Pacific Golden-Plovers and Ruddy Turnstones. They range from 1,500 feet (457 m) to 6,000 feet (1,829m) elevation on Hawai'i's mountains: the Kohalas, Mauna Kea, Mauna Loa, and Hualalai. The most important are those of the Kohala Mountains (K.Uyehara pers. obs.). Typically the best pastures for shorebirds are those that receive greater than 60 inches (152 cm) of rainfall per year, are regularly grazed, and have fairly flat topography (A. Engilis pers. obs). An example is the pastures of the Kehena region of the Kohala Mountains. These become increasingly wet as you proceed towards the summit ridge of the mountains. At the 60" isocline, the pasture remains wet and sedges and other wetland indicators are common plants. In these zones shorebird numbers can be quite impressive with flocks of over 100 golden-plovers recorded (K. Uyehara pers. obs). Lowland pastures also provide habitat for golden-plovers and turnstones, and are also used sparingly by Bristle-thighed Curlews. Among those frequented by the latter are pastures on Hawai'i's South Point.

Shorebird Species

Forty-seven species of shorebirds have been recorded in the Hawaiian Islands (Appendix 2). These can be grouped into three categories – resident - winter visitors – and vagrants. Only the Hawaiian Stilt is resident (and endemic). Common winter visitors include Pacific Golden-Plover, Bristled-thighed Curlew, Wandering Tattler, Ruddy Turnstone, and Sanderling. In addition to the common winter visitors are several that occur annually but in small numbers. These are Black-bellied Plover, Lesser Yellowlegs, Least Sandpiper (*Calidris minutilla*), Pectoral Sandpiper, Sharp-tailed Sandpiper, Dunlin, and Long-billed Dowitcher. The remaining species are not regular or have occurred few times in the state. Hawai'i is of primary importance for four species: Hawaiian Stilt, Pacific Golden-Plover, Bristle-thighed Curlew, and Wandering Tattler.

Pacific Golden-Plovers use the widest range of habitats and can be seen from sea level to 13,000⁺ feet (3,960m). They are most common on uplands, frequent parks, pastures, and open wetlands. Most species that over winter in Hawai'i can be found in a variety of habitats not typically expected (e.g. mudflats for Wandering Tattlers). Ruddy Turnstones utilize high elevation pastures, isolated beaches, flats and park lawns. Sanderlings seem most faithful to mudflats, beaches, and open marshes. Bristle-thighed Curlews prefer undisturbed, predator-free habitats and most over-winter on the small, secluded Leeward Islands where an estimated 8% of the world population is recorded. Small numbers winter on the Main Islands where dogs are controlled, or water is available for escape. Two wintering sites include Kahuku Point, O'ahu, and Pala'au Flats, Moloka'i, the latter site was only recently discovered (Ducks Unlimited 1996).

No comprehensive surveys of the entire chain are available to assess the status of migratory shorebirds in Hawai'i. Various surveys of specific habitats or individual islands are available but the trends indicated by these incomplete surveys are often contradictory e.g. statewide waterbird surveys (Engilis 1988), Christmas Bird Counts (Table 2), and O'ahu golf courses (Johnson and Johnson 1993). To examine trends, all that is available are Christmas count data, which is not standardized. For Pacific Golden-Plover, the Honolulu Christmas Count has the widest array of habitats used from tidal flats to grass parks and thus may provide some insight as to the population trend in the islands (Fig. 8). These data suggest an increase in the islands since the 1940s. A significant action occurring at the beginning of the count (early 1940s) was the curtailment of plover hunting in the islands in 1941 (Schwartz and Schwartz 1949). The development of a comprehensive monitoring program is a high priority.

The Hawaiian Stilt is the only endemic shorebird found in U.S. Pacific Islands. It is endangered, but at present the population is relatively stable, but at low numbers. Limiting factors include habitat loss, predation by alien mammals, and habitat degradation. Stilt share habitat with three other endangered waterbirds, Hawaiian Coot (*Fulica alai*), Hawaiian Moorhen (*Gallinula chloropus sandvicensis*), and Hawaiian Duck (*Anas wyvilliana*) and a Recovery Plan for the Hawaiian Waterbirds provides detailed information on this species (USFWS 1999). The Hawaiian Stilt is coastal in its distribution and it is found on all the Main Islands except Kaho'olawe. Inter-island movements are common on a seasonal and perhaps even daily pattern (Reed et al. 1998). As with other recurvirostrids, the Hawaiian Stilt is a bird of open, early succession marshes and mudflats. Ephemeral wetlands, managed wetlands, and coastal playays are critical for this species.

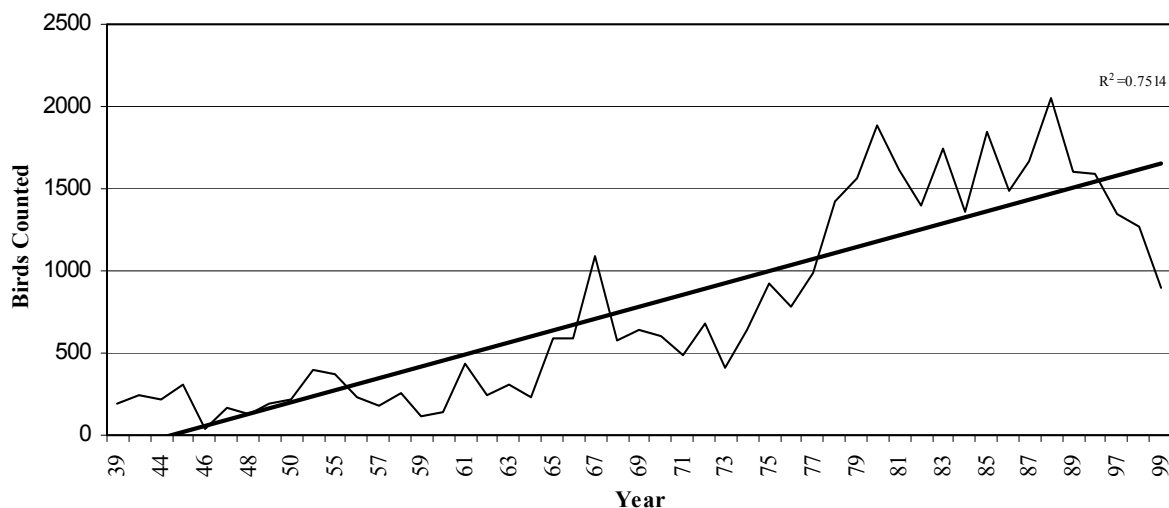


Figure 8. Pacific Golden-Plover counts, Honolulu Christmas Count (Source: NAS 2000, 2001).

Regional Population Goals

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- ⇒ Increase the populations of Hawaiian Stilt to 2,000 birds, and maintain for ten years (delisting criteria)
- ⇒ Assure multiple breeding colonies of Hawaiian Stilt on several main islands (delisting criteria)
- ⇒ Increase populations of Bristle-thighed Curlews wintering in the Main Islands
- ⇒ Maintain stable or increasing populations of curlews in the Leeward Islands
- ⇒ Maintain or increase populations of Pacific Golden-Plover, Wandering Tattler, Ruddy Turnstone, Sanderling, and other migratory shorebirds
- ⇒ Accurately assess the population size of over-wintering and migrating Pacific Golden-Plovers, Bristle-thighed Curlews, and Wandering Tattlers and coordinate with Alaska to develop quantitative population goals

Regional Habitat Status, Threats and Management Needs

In order of habitat priority, the following are specific recommendations for the Hawaiian Subregion.

Tidal Flats and Estuaries

The primary threats to this habitat are the spread of Red Mangrove and contaminants. Restoration through eradication of mangrove, followed by maintenance has met with success in the Nu'upia Pond complex, O'ahu (Drigot 2001), but where maintenance does not follow removal, the flats quickly become overgrown again as in the West Loch Project, Pearl Harbor. Pearl Harbor has experienced countless fuel and chemical spills over the past 5 decades and more can be expected in the future. Four hazardous waste sites at Pearl Harbor Naval Base have been identified by the U. S. Environmental Protection Agency (EPA) as superfund National Priorities. The Navy has identified 31 potential hazardous sources in Pearl Harbor alone. Hawai'i's estuaries are also impacted by non-point source pollution and sedimentation of flats has accelerated as a result of land use in the watershed (USFWS 1996). Thus as a wetland habitat type, tidal flats are among the most degraded in the Islands.

- ⇒ Remove and control mangrove encroachment in tidal flats specifically in West Loch of Pearl Harbor, Kaneohe Bay, Kewalo Basin, Moloka'i's south shore, and in smaller impacted areas on all islands
- ⇒ Combat the spread of mangrove in the Hawaiian Islands
- ⇒ Protect remaining habitat from development and fill in Kewalo Basin, Pearl Harbor, Kaneohe Bay, and other estuarine systems
- ⇒ Monitor habitats for contaminants and coordinate with response teams for contaminant clean ups of spills

Playas and ephemeral basins

The protection, restoration, and management of playa wetlands in the Hawaiian Islands is deemed critical for the recovery of Hawaiian Stilt and maintenance of migratory shorebird populations (USFWS 1999). Major playas are still functional on Ni'ihau, O'ahu, Maui, and Moloka'i. On all islands, the main threat to playas has been the introduction of pickleweed and Indian Fleabane. These aggressive plants have completely covered most coastal playas resulting in increased rates of siltation and accretion. In addition, accelerated sedimentation resulting from poor management of upland agricultural and ranch lands has heavily impacted playas (particularly on O'ahu and Moloka'i). The largest protected playa is Kealia Pond, but fleabane and pickleweed continue to encroach on the site. Annual drawdowns of Kealia

Ponds have created problems with the local community due to the stench of dead fish, midge (Chironomidae) blooms, and blowing dust (a natural deflation event characteristic of coastal playas). Political pressures are being placed on the USFWS to not drain the pond annually, a management action that is critical for Hawaiian Stilt and migratory shorebirds.

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- ⇒ Restore protected and/or degraded playa wetlands such as Mana Plains (Kauaʻi), Palaʻau Flats (Molokaʻi), Kealia and Kihei wetlands (Maui) and Kahuku Point (Oʻahu)
- ⇒ Eradicate/control exotic plants and restore the natural hydrology to playa wetlands
- ⇒ Survey, assess, and develop management strategies for important playas on Niʻihau
- ⇒ Work with private landowners to restore and manage wetlands through cooperative and incentive programs (WRP, WHIP, PIF, NAWCA)

Permanent, Semi-permanent Wetlands

Coastal permanent and semi-permanent wetlands are used with less frequency by shorebirds than coastal strands and ephemeral wetlands and playas. Most are also linked, hydrologically to montane watersheds. They suffer the same threats as ephemeral wetlands, overgrowth with alien plants, and loss to urban encroachment. Most of the large wetlands in Hawaiʻi are protected by agencies but most have limited value to shorebirds due to poor habitat quality. Habitat restoration, vegetative clearing, and long-term management are required on these wetlands. We refer the reader to the Hawaiian Endangered Waterbirds Recovery Plan for detailed needs and actions related to Hawaiʻi's wetlands.

- ⇒ Restoration and management of wetlands to benefit shorebirds and native waterbirds (target wetlands identified in the Hawaiian Waterbird recovery Plan)
- ⇒ Protection of important wetlands under private ownership through easements, landowner agreements or, if willing sellers, acquisition.
- ⇒ Control and eradication of alien, invasive plants
- ⇒ Coordinate restoration and protection of wetlands with Hawaiian Waterbirds Recovery Plan, USFWS and State of Hawaiʻi

Man-Managed Water Projects (not wildlife related)

The cultivation of wetland Taro (*Colocasia esculenta*), lotus (*Lotus* spp), and various mariculture activities provide habitat for Hawaiʻi's shorebirds. These cultivated wetlands are most common on Kauaʻi, Oʻahu, Molokaʻi, Maui, and Hawaiʻi. Cultivated wetlands are transient, in relation to long-term efforts to conserving habitats and maintaining populations of shorebirds. However, birds do become dependent upon them and local populations of Hawaiian Stilt and migratory shorebirds can be impacted if the practices are abandoned due to economic pressures. An example of this can be seen with the collapse of the sugar cane industry in Hawaiʻi, and loss of wastewater ponds, reservoirs, and conversion of agricultural lands into urban areas. Minimizing dependence on cultivated wetlands must be made a priority by agencies as part of the recovery actions needed for endangered Hawaiian waterbirds. These actions will also benefit migratory shorebirds.

- ⇒ Minimize dependence on these habitats through improved shorebird habitat management on state and federal refuges and reserves, particularly Hawaiian Stilt
- ⇒ Monitor shorebird use to compare use with natural or wildlife managed sites
- ⇒ Seek Safe Harbor or Habitat Conservation Plans for man managed water projects to minimize take issues for Hawaiian Stilt
- ⇒ Investigate the effectiveness of aquaculture management in relation to wetland management

Sand Beach and Dunes

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The most important beach and dune resources are located in the Northwestern Hawaiian Islands. These are critical habitat for wintering Bristle-thighed Curlews and important for turnstones and Pacific Golden-Plovers. The main threats to the beaches are human generated trash and contaminants that wash up on the beaches by the tons (Fig. 9). In addition, these islands are impacted from oil spills and tar balls of unknown sources that continually wash up on these remote islands impacting wildlife. There are few beach sanctuaries in the Main Islands. Exceptions include Ka`ena Point, O`ahu and Mo`omomi Dunes, Moloka`i protected under the Natural Area Reserve System; and, National Park lands on Hawai`i and Maui. Beach access is not fully restricted by these agencies although in most cases vehicles and other destructive uses are prohibited. The main threat to shorebirds on Main Island beaches continues to be human disturbance.

- ⇒ Restoration of dunes on O`ahu, Moloka`i, and Maui and restricting ORV access to support native vegetation and habitat used widely by shorebirds, principally the Bristle-thighed Curlew
- ⇒ Maintain secure beach and dune habitat in the Northwestern Hawaiian Islands
- ⇒ Eliminate introduced mammals from all Leeward Islands
- ⇒ Control mammals in all Natural Area Reserves (State) or Federally protected beaches
- ⇒ Monitor and maintain Leeward Islands as mammal free
- ⇒ Monitor Leeward Islands for trash accumulation, clean periodically to maintain beaches and strand habitat
- ⇒ Monitor beaches for oil and other contaminant issues, participate in response teams for emergency actions

Grasslands

Open and grazed grasslands are important habitats for wintering Pacific Golden-Plovers. The largest tracts are on private ranch lands located on Hawai`i and Maui where current management restricts public access, and there is little threat from human disturbance. The primary issue with these grasslands is the best long-term use of the land, both from an economic and ecological perspective. Reforestation of native forests (for native forest birds) has been initiated, as have plantations for commercial production of Koa (native). Eucalyptus (non-native) plantations for paper pulp are also developing. As the cattle industry becomes more and more competitive, private landowners, particularly when considering the value of land in Hawai`i, may explore other uses of pastoral lands. Management of pastoral lands has been proposed on Hawai`i and Kaua`i to support Hawaiian Goose (*Branta sandvicensis*) and migratory shorebirds could also benefit.

- ⇒ For upland grasslands develop Safe Harbor Agreements with landowners to protect grazed pasture as part of ongoing efforts to provide habitat for Hawaiian Duck and Goose; incorporate shorebird needs
- ⇒ Develop Regional Habitat Conservation Plans for wetland and grassland management, incorporating shorebird needs, in coordination with landowners and agencies targeting key grassland regions (upslope Maui, Kohala Mountains, and upslope Mauna Kea)
- ⇒ Coordinate reforestation efforts to incorporate grassland habitats to benefit a broad group of organisms
- ⇒ Maintain state and federal protected lowland grasslands from invasive plants such as Indian Fleabane, Fountain Grass, and other invasive shrubs
- ⇒ Seek to include grazing regimes in diversified farming operations by coordinating with landowners

- ⇒ On lawns and golf courses promote integrated pest management practices to minimize pesticide use

Rocky Shoreline/Offshore Islets

This habitat resource is relatively secure and is probably important for Wandering Tattlers, but provides only limited habitat for other shorebirds. Uninhabited offshore rocks and islets are important as roost sites for shorebirds. Several have, in the past, been invaded by mammals (Rats, cats, and rabbits). On most islands these mammals have been removed by staff of the Hawai'i Division of Forestry and Wildlife (DOFAW). The re-colonization of islets by mammalian predators and human disturbance remain the principal threats to roost sites for shorebirds. Human access is currently restricted, but increased activity could pose a threat to shorebird.

- ⇒ Remove all introduced mammals from offshore islets
- ⇒ Maintain predator free, relatively undisturbed roost habitats
- ⇒ Restrict human access to minimize disturbance

Predator Control

Hawai'i has no native terrestrial mammals (except for a single species of bat). Introduced mammals, particularly Indian Mongoose (*Herpestes javanicus*), rats (*Rattus rattus*, *R. norvegicus*, *R. exulans*), feral cats (*Felis sylvestris*) and dogs (*Canis familiaris*) depredate native shorebirds reducing their populations and limiting suitable habitat. Rats have been eradicated from Midway and Kure Atolls in the Northwestern Hawaiian Islands and the only remaining predator in the leeward chain is the house mouse, at Midway Atoll. Additional, specific predator actions are restated in habitat sections (above).

- ⇒ Develop and maintain a predator control program particularly on O'ahu, Moloka'i, Maui, and Hawai'i, to protect Hawaiian Stilt and Bristle-thighed Curlews
- ⇒ Monitor the Northwestern Hawaiian Islands regularly to detect predator introductions and initiate immediate eradication efforts
- ⇒ Eliminate invasion routes by Brown Tree-Snake (*Boiga irregularis*) from other Pacific Islands

Monitoring Priorities

- ⇒ Continue and standardize statewide biannual monitoring of Hawaiian Stilt populations.
- ⇒ Develop best management practices for managed wetlands and monitor response for Hawaiian Stilt
- ⇒ Develop a monitoring program for migratory shorebirds with initial emphasis on golden-plovers, Bristle-thighed Curlews and Wandering Tattlers
- ⇒ Monitor shorebird response to habitat restoration to support adaptive management approach to wetland and tidal flat conservation
- ⇒ Assess importance of ephemeral playas, beaches, and dry grasslands for shorebirds on Ni'ihau.
- ⇒ Monitor trash accumulation (to target clean up efforts) on Northwest Hawaiian Islands to minimize impact on wintering shorebirds
- ⇒ Monitor and prevent introduction of Brown Tree Snakes to the Hawaiian Islands
- ⇒ Monitor and prevent spread of mongoose to mongoose free islands (Lana'i, Ni'ihau, Kaho'olawe, and Kaua'i)

Research Priorities

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- ⇒ Investigate population dynamics and inter-island movements of Hawaiian Stilt and determine the importance of playa wetlands (especially on Ni'ihau) to the maintenance of stilt populations
- ⇒ Analyze data from USFWS and DU restoration projects to develop best management recommendations for Hawaiian Stilt and distribute information to land managers
- ⇒ Develop habitat management priorities for Hawaiian Stilt
- ⇒ Evaluate the effects, on migrant shorebird numbers, of different vegetation and water levels as a result of active management
- ⇒ Evaluate the effects of pesticides on golden-plovers utilizing managed grass lawns (golf courses, lawns, pastures, etc.)
- ⇒ Identify important wintering sites, migratory stopover sites, and assess population trends of Bristle-thighed Curlews in Hawai'i
- ⇒ Ecology of Bristle-thighed Curlews on the wintering grounds including foraging habits, habitat requirements, and limiting factors
- ⇒ Assess golden-plover populations wintering and migrating through the region especially as it relates to habitat use and selection. Identify important staging areas
- ⇒ Research the removal and control of invasive plants including Red Mangrove, Indian Fleabane, and *Batis*
- ⇒ Investigate competition with Tilapia, design managed wetlands to control Tilapia invasions
- ⇒ Quantify use of wastewater treatment ponds in relation to managed or natural wetlands
- ⇒ Improve wetland management strategies and compare with aquaculture management (e.g. Taro) to develop landscape efforts
- ⇒ Investigate the impacts of grazing on shorebird habitat use in pastures
- ⇒ Investigate the migration routes of curlew, golden-plover, and tattler and determine Hawai'i's role and linkages to Alaska and Asian populations

Education Priorities

- ⇒ Educate the public about migratory and resident shorebirds including the importance of shorebird habitats (wetlands, tidal flats, grasslands, beaches)
- ⇒ Develop education curricula looking at migration for grade school students
- ⇒ Involve schools and the public in monitoring program for golden-plover
- ⇒ Establish golden-plover as a centerpiece for a wildlife festival. Seek support from Hawai'i Tourism Office
- ⇒ Develop a "shorebird trunk" available to schools and other institutions with information, activities, games, books, etc

Implementation and Coordination

The conservation of shorebirds (endemic and migratory) must be undertaken as part of a broad, landscape approach to wetlands, beach strand, grassland, and upland conservation. With increasing need to accelerate endangered species recovery, conserve and protect wetlands and beaches, and promote conservation based research and management, the time is right to coalesce the active partners in the Hawaiian Islands to form a habitat joint venture. At the present time there are many agencies and activities ongoing in the state, but none are coordinated to achieve statewide goals, particularly involving migratory shorebirds.

Partners in such an effort could include such agencies as U.S. Fish and Wildlife Service, State Department of Land and Natural Resources, U. S. Natural Resource Conservation Service, U. S.

Environmental Protection Agency, National Park Service, National Marine Fisheries Service, U. S. Department of Defense, Hawai`i Department of Education, Hawai`i Department of Agriculture. Private Sector would include groups such as, Ducks Unlimited, Inc., The Nature Conservancy, Hawai`i Audubon Society, Hawai`i Nature Center, and research universities. 36

- ⇒ Develop Hawai`i Habitat Joint Venture
- ⇒ Coordinate activities with Endangered Species Recovery efforts
- ⇒ Encourage, on the ground, private and public partnerships to achieve habitat and population objectives

Mariana Islands Subregion

Description of Subregion: The Mariana Islands include the island of Guam (Territory of the United States) and the Commonwealth of the Northern Mariana Islands (CNMI) (15 islands) (Fig. 10). The chain extends from 13° to 21° North Latitude and 144° to 146° East Longitude in the western Pacific Ocean. Guam, along with Rota, Agiguan, Tinian, and Saipan are inhabited by humans, although small settlements occur on a few of the northern islands. The entire landmass of the chain is approximately 1,015 km², less than one tenth the size of the single Island of Hawai'i. The largest island is Guam (554 km²). The Mariana Islands are comprised of a combination of volcanic and uplifted limestone rock. The northern islands are mostly step rock islets that receive little rainfall. They are typically barren and support little habitat for shorebirds, except for rocky shorelines. The southern islands (including Guam, Saipan, Rota, Tinian, and Aguijan) are larger and forested or support coastal plain woodlands and grasslands. These islands are characteristically flat: the highest peak is 1,506 ft (459 m) on Rota, highest elevations on Guam reach only 492 ft (150 m).

The Marianas provide only limited resources for migrant shorebirds. The best habitat is on Guam and Saipan (Stinson et al. 1997a, 1997b). The Mariana Islands experience two distinct seasons, wet and dry. Guam receives 79 in (200cm) of rain per year, falling predominately from June through November, the remainder of the year is dry. Consequently wetland acres vary. Ephemeral basins with short grass and exposed mud and shallow pools provide the most important habitat for migratory shorebirds wintering in the islands. These basins dry by December or January when most migrant birds are forced to concentrate on few remaining wet areas or depart the Islands (Stinson et al. 1997b). Many of the seasonal wetlands are choked with reed thickets and other weedy species and are not used by shorebirds. Farming activities help to reopen some choked sites. Wet farm fields also provide habitat especially in the fall. Larger expanses of short grass habitats associated with military bases, airports, golf courses, fields, and residential parks are utilized by golden-plovers and, to a lesser extent, turnstones. As in Hawai'i, acreage of these latter habitats has increased over the last century.

Wetlands of Importance to shorebirds

Guam: Guam, being the largest island in the group, supports the most diverse setting of wetlands in the Marianas. Permanent wetlands are centered in four geographic regions (Talofofo River, Fena Valley, Atantano Marsh, and Agana Marsh). These wetlands are deep water habitats comprised of Pago tree swamps (*Hibiscus tiliaceus*) and are over grown by reeds (*Phragmites*) and bulrushes (*Scirpus*). These provide little available habitat for shorebirds. More important for shorebirds are the numerous depressions that fill as ephemeral ponds. Most are in agricultural settings and have degraded hydrology and support grasses and sedges. The importance of these wetlands is punctuated by the increase in acreage associated with seasonal rains. The base wetland acres on Guam average 316 ac (128 ha) during the dry season (USFWS 1996). These are expanded to greater than 740 ac (300 ha) during the wet season. Man-made wetlands such as Fena Reservoir have further altered the wetlands landscape on Guam. Guam's western shore is lined with tidal flats and small estuaries that are used by wintering shorebirds. Over 170 ac (69 ha) of mangrove exist. Unlike Hawai'i, these mangrove forests are native and important for local fish and coastal species. They support a few shorebirds such as tattlers.

CNMI: The smaller islands of the CNMI have restricted wetlands used by shorebirds. Lake Susupe complex, located on Saipan, comprises over 60% of the wetland habitat in the CNMI. Susupe is a brackish pond 42 ac (17 ha) in size. *Phragmites*, *Scirpus*, sedges and water ferns line its shores. Associated with Susupe are 458 ac (185 ha) of ephemeral ponds flooded only during the wet season. The main pond supports few shorebirds. More important for shorebirds are the small ephemeral basins scattered along Saipan's western shore comprising approximately 90 ac (37 ha) of habitat. Many are overgrown with grasses, reeds, and sedges. The remaining wetlands of Saipan are seasonal in nature,

filling during wet months and providing important foraging habitat for migrant shorebirds (turnstones, plovers, tattlers, *Tringa* spp). Other significant habitats used by shorebirds are tidal estuaries and mangrove swamps (*Bruguiera gymnorhiza*) near Garapan. Limestone benches and exposed reefs dot Saipan's western shoreline. Emergent surfaces of these support migrant shorebirds. Tinian is the only other island with semi-permanent wetlands. The most important is Lake Hagoi, at 10 ac (4 ha). It is surrounded by 48 ac (20 ha) of ephemeral pools. Today, only about 2.4 ac (1 ha) of Lake Hagoi remain in open water, the remaining is overgrown with *Scirpus* and *Phragmites*. Tinian was heavily bombed during WWII creating depressions that fill in the wet season. A cluster of these is located near the south end of the island at Magpo Wetland, 27 ac (11 ha). Rota supports limited ephemeral wetlands and those that existed on Pagan were destroyed by volcanic eruption in May 1981 (USFWS 1996).

Beaches and Rocky Shoreline of Importance to Shorebirds

The remote islands of the Northern Marianas are uninhabited and support strand beaches used by shorebirds such as golden-plovers, turnstones, and tattlers. Beaches with intertidal zones mud or sand flats) are preferred. Key among beach sites are Tanapag and Puerto Rico beaches (Saipan) and Duncas Beach (Guam) (Stinson et al. 1997b). On the larger islands, beaches provide little habitat for migrant shorebirds, in part due to human recreation and resorts. Rocky shorelines are extensive, especially on the northern islands. This habitat is utilized by tattlers, but is extremely remote and difficult to survey for shorebirds.

Grasslands and open spaces of Importance to Shorebirds

Guam and Saipan support the only pastoral lands that are used by migrant shorebirds. Urban parks, golf courses, antenna fields, and grass edges of runways are frequented by golden-plovers and turnstones. Oddly enough the large concreted runways, abandoned after WWII on Tinian are used as loafing sites by golden-plovers in particular. During rainy periods, concrete runways can flood and shorebirds congregate to bathe and loaf, some ancillary foraging may occur in pools on the tarmac.

Shorebird Species

Forty-six species of shorebirds have been recorded in the Mariana Islands, most breed predominately in Asia, but the islands may also support some North American populations (Appendix 2).

Of these only the Pacific Golden-Plover is abundant (Jenkins 1981, Stinson et al. 1997b). Whimbrel (*Numenius phaeopus variegatus*), Ruddy Turnstone, Wandering Tattler, and Grey-tailed Tattler are common to uncommon (Table 6). Another four species, all Asian breeders, are regular in very small numbers (10 – 50 birds per year): Mongolian Plover (*Charadrius mongolus*), Wood Sandpiper (*Tringa glareola*), Common Sandpiper (*Actitis hypoleucos*), and Red-necked Stint (*Calidris ruficollis*) (Stinson et al. 1997b). There are no resident shorebirds in the Mariana Islands. Few estimates of shorebird numbers are available for the Marianas. Baker (1951) and Owen (1977) summarized early 20th century accounts. The most recent estimates of relative abundance are provided by Jenkins (1981) and Stinson et al. (1997b). Reichel and Glass (1991) and Stinson (1994) provide a checklist of birds of the Mariana Islands with general categorization of abundance. Stinson et al. (1997b) estimate between 5,000 and 20,000 golden-plovers pass through the islands and a few thousand over winter, and Ruddy Turnstone wintering numbers fluctuate at several hundred birds. They give no estimates for tattlers in the Marianas probably due to identification problems associated in separating both species. All other species occur in very low numbers (fewer than 200 birds). Radar studies indicate that only a small percentage of migrants stop at the Marianas. Most over-fly, probably on non-stop flights from Asia to the South Pacific, but exact patterns are poorly understood (Williams and Williams 1988).

Table 6. Shorebirds recorded on the 2000 Christmas Counts, Guam, Saipan, and Rota. (Source: NAS 2000, 2001).

| | Pacific Golden-Plover | Ruddy Turnstone | East Asian Whimbrel | Tattlers (Gray-tailed and Wandering) | Other species (mostly Asian spp) |
|-------------|-----------------------|-----------------|---------------------|--------------------------------------|----------------------------------|
| South Guam | 141 | 47 | 65 | 8 | 48 |
| Dededo Guam | 258 | 40 | 2 | 2 | 47 |
| Rota | 203 | 47 | 11 | 4 | 5 |
| Saipan | 284 | 53 | 0 | 3 | 10 |
| Totals | 886 | 187 | 78 | 17 | 110 |

Regional Population and Habitat Goals

The population status of migrant shorebirds in the Marianas is unknown. As in Hawai'i, several species wintering in the Marianas exploit a variety of habitats. Pacific Golden-Plovers over-winter in close association with humans. They forage on lawns, fields and other short-grass habitats, and roost on tarmacs of military fields, and rooftops. Without a better understanding of existing populations and trends, it is impossible to set population goals. Key in the Marianas is the protection and management tidal flats, beaches, ephemeral wetlands and grassy areas utilized broadly by many species of shorebirds.

- ⇒ Conduct surveys to determine existing population levels for Pacific Golden-Plover and assess habitat use
- ⇒ Conduct island wide shorebird survey to quantify population levels and habitat associations
- ⇒ Manage existing wetlands, with emphasis on protection and restoration of wetlands and tidal flats
- ⇒ Develop GIS system that identifies and ranks key shorebird habitats in Mariana Islands

Regional Habitat Status, Threats and Management Needs

Wetlands

Impacts to wetlands in the Mariana Islands is generally divided into two categories: agriculture prior to WWII and urbanization and military development after WWII. Agricultural development has resulted in the loss of numerous ephemeral basins through land leveling and plowing. Larger wetlands were drained and diked to cultivate rice, taro and for public health reasons (USFWS 1992). During WWII, Japanese occupation expanded rice and taro production at the expense of wetlands on Guam, Saipan and Tinian. Forest clearing increased evapotranspiration drying ephemeral pools in forests (Nakajima 1944). Over the past two decades, the economies of the Mariana Islands have become more dependent on tourism and have moved away from subsistence-based lifestyle. The military continues to have a major presence in the Marianas. As the human population increases, so too will the need for more development. To support tourism, pressures have been placed on wetlands, estuaries, and beaches particularly on Guam and Saipan; the islands that support the highest numbers of shorebirds. No estimates as to the loss of wetlands on Guam are available, but nearly 65% of Saipan's wetlands have been lost due to human actions (Stinson et al. 1991). Coastal wetlands can also be affected by well development, impacting aquifers that support perched wetlands along the coast of larger islands. Little emphasis has been placed on the protection of ephemeral basins and they continue to be farmed and hydrologically altered. The protection of major wetlands has, for the most part, been achieved but without active management these systems will become choked with vegetation that does not provide habitat for shorebirds. What remains is active restoration and management of the resources to benefit native and migrant waterbirds. However, *Phragmites* and *Scirpus* thickets do provide habitat for two

endangered species (Mariana Moorhen - *Gallinula chloropus guami* and Nightingale Reed-Warbler - *Acrocephalus luscini*) and thus a balance of open wetlands vs. vegetated wetlands must be struck (USFWS 1992, USFWS 1995). Recovery actions recommended for the Mariana Moorhen and Nightingale Reed-Warbler address the need to restore and manage habitat and reduce predation by introduced mammals and Brown Tree-Snake (*Boiga irregularis*). In Hawai'i and in continental populations, ephemeral wetlands are used by moorhens and prove important as dispersal habitat and should be coordinated with shorebird efforts (Nagata 1983, Stinson et al. 1991a). The protection, restoration, and possibly even the creation of wetland complexes that support permanent wetlands associated with ephemeral basins should be developed on Guam, Tinian, and Saipan.

- ⇒ Incorporate habitat considerations for shorebirds into management strategies for wetlands on Guam and CNMI (Lake Susupe, Hagoi, Atantano Marsh, and Agana Marsh). Mesh habitat needs of shorebirds with those of reed warbler and moorhen
- ⇒ Seek funds to help restore ephemeral marshes at key wetland complexes through vegetation removal or control
- ⇒ Develop management strategies to maintain ephemeral wetlands free of invasive vegetation.
- ⇒ Coordinate with recovery actions for endangered wetland species

Tidal Flats, Beaches, and Mangrove Estuaries

Historical loss of tidal habitats was accelerated by the USDOD between 1945-1950. During this period an estimated 1,200 acres (485 ha) of land area that included mangroves and wetlands were filled along the west-central coast of Guam (USFWS 1996). The majority of tidal flats, beaches and mangrove estuaries that remain on Guam are owned by Territorial or Federal agencies. Threats on these systems include pollution, contaminants and fuel spills associated with increasing human populations and military activities particularly on Guam and Saipan where most of the Islands key tidal flats occur. Numerous oil spills, offshore of Saipan, Guam, and Tinian, have been documented by the USFWS (1996). Increasing tourism will undoubtedly put pressures on developing prime beach locations on Saipan, Guam, and even Tinian. Specific Recommended Actions include:

- ⇒ Coordinate with USDOD to support habitat protection of tidal and beach habitats as part of overall land management strategy
- ⇒ Seek protection status for key beach and tidal flat habitats (examples include: Tanapag and Puerto Rico (Saipan) and Dungcas (Guam))
- ⇒ Address potential contamination of Puerto Rico Mudflat from the Saipan Dump and effect cleanup if needed
- ⇒ Monitor habitats for contaminants
- ⇒ Coordinate with response teams for damage assessments, contaminant clean ups, or emergency response to spills

Agricultural Lands

Agricultural lands on Guam and Saipan support wintering Pacific Golden-Plovers. More importantly, agricultural lands of interior Guam support numerous basins that fill during the rainy season. These are an important resource for wintering shorebirds on Guam. Agricultural lands remain threatened from expanded human development and conversion to housing. Easement programs through Natural Resources Conservation Services (NRCS) might serve to help establish land easements. Cultivated wetlands are not a significant resource in the Mariana Islands.

- ⇒ Identify and map key agricultural areas that support ephemeral wetlands and target for restoration and protection

- ⇒ Expand opportunities for agricultural lands easements or cooperative agreements to protect open space from development pressures (NRCS, USFWS programs)
- ⇒ Protect open space and agricultural lands through easements and or cooperative agreements

Introduced Predators

The extinction of Guam's avifauna has been directly attributed to the spread of the introduced Brown Tree-Snake (*Boiga irregularis*) (Savidge 1987). The impact of Brown Tree-Snake on migrant shorebirds is unknown, but should be addressed in any conservation plan involving migrant shorebirds. It could become a serious problem throughout the Pacific if accidentally introduced to other islands. Currently it is restricted to Guam, but records from Saipan and Hawai'i continue to occur as snakes stow-away on airplanes and boats. The introduction of Brown Tree-Snake to islands that support Bristle-thighed Curlews or resident endangered species such as Hawaiian Stilt or Tuamotu Sandpiper could be catastrophic for those species. An international effort has been developed to prevent the spread of the Brown Tree-Snake to other Pacific Islands (USFWS 1996).

Introduced mammals, especially rats and feral dogs remain a high risk as a limiting factor in the survival of resident and migrant waterbirds. The degree of threat or competition by rats with endemic avifauna remains undocumented at this time but may be limiting species recovery efforts involving Guam Rail (*Rallus owstoni*), moorhen, and reed-warbler. The impact on migrant shorebirds is undocumented.

- ⇒ Seek for control and ultimately eradication of Brown Tree-Snake
- ⇒ Control introduced mammalian predators at key wetland complexes in the islands
- ⇒ Eradicate from islands introduced mammals and reptile predators where feasible
- ⇒ Do not allow the snake to spread to other Mariana Islands or other USPI
- ⇒ Establish a monitoring program for the early detection of Brown Tree-Snake and introduced mammals on predator free islands
- ⇒ Develop response plan for quick eradication in the event introduced predators are detected

Monitoring Priorities

- ⇒ Institute regular surveys to assess species, abundance, population trends and habitat utilization of migratory shorebirds. Focus should be placed on the nine species that are uncommon to abundant in the islands (Appendix 2)
- ⇒ Develop and standardize Guam and CNMI biannual waterbird monitoring program inclusive of migrant shorebirds
- ⇒ Develop a monitoring program to assess population and habitat associations for migratory shorebird with initial emphasis on golden-plover, Ruddy Turnstone, Whimbrel, and tattlers
- ⇒ Monitor shorebird response to habitat restoration to support adaptive management strategies as a component of wetland and tidal flat conservation
- ⇒ Monitor for contaminants and spills on beaches, wetlands, and tidal flats that are important for shorebirds

Research Priorities

- ⇒ Identify where wetlands or grasslands can be created in an effort to balance habitat needs with urban growth (GIS coordinated)
- ⇒ Develop baseline surveys of uninhabited islands to document species diversity and abundance.

- ⇒ Investigate habitat use and shorebird occurrence in the islands and quantify the importance of habitat type to maintenance of shorebird numbers
- ⇒ Develop adaptive management strategies for ephemeral wetlands
- ⇒ Continue research of life history and control efforts on Brown Tree-Snake
- ⇒ Assess impact of introduced mammals

Education Priorities

- ⇒ Educate the public about migratory shorebirds.
- ⇒ Educate the public on the importance of shorebird habitats (wetlands, tidal flats, grasslands, beaches)
- ⇒ Education of USDOD Personnel on shorebird ecology, threats (predators and disturbance) and important habitats: beaches, dunes, mudflats, wetlands, and grassy areas
- ⇒ Develop education curricula on migration, understand connectivity of the Mariana Islands to other regions of the globe
- ⇒ Involve schools and the public in monitoring program for golden-plover

Implementation and Coordination:

Coordination with development and economic plans for expanding tourism needs to be prioritized. The USFWS has developed a multi-agency partnership with the USDOD for the protection, development, and management of fish and wildlife resources on Guam and Tinian. Natural areas on public and private lands are protected by local and federal regulations but are not under cooperative management. Key areas under these categories need to be prioritized by local governmental agencies and the USFWS. The USFWS (Guam, Rota) and the CNMI Division of Wildlife have expanded efforts to develop an island-wide ecosystem planning effort through the development of Habitat Conservation Plans for each island (HCP). These HCPs address habitat fragmentation, important wetlands resources, and attempt to address conservation with economic growth and development within watersheds. They also attempt to link the recovery actions for endangered species in the islands. Although the conservation of migratory shorebirds in the Mariana Islands will not be of primary focus in the development of HCPs and other planning efforts, resource managers should recognize the benefits of such efforts in the maintenance of shorebird populations in the Marianas. Two endangered species use wetland habitats in the Marianas, the Mariana Moorhen and Nightingale Reed-Warbler. Recovery plans call for protection of wetlands for both species.

American Samoan Islands Subregion

Description of Subregion – American Samoa comprises five high islands (Tutuila, Aunu`u, Ta`u, Olosega, and Ofu) and two coral atolls (Rose and Swains) (Fig. 11). This plan does not cover the independent nation of Western Samoa: Savai'i and Upolu. American Samoa is located at 14° S and from 168° - 171° W. All of the islands are volcanic, and high except for Rose and Swains. The high islands rise steeply from the ocean, supporting rugged interior forests and narrow coastal plains. The islands receive from 125 – 300 inches (317 – 762 cm) of rainfall annually, with higher precipitation in the uplands. They range in size from 395 ac (1.6 km²) (Aunu`u) to 54.8 mi² (142 km²) (Tutuila) and the highest peak is 3,166 ft (965 m) (Ta`u). Coastal areas receive 125-150 inches (317 – 381 cm) per year, most falling between October and March. Wetland acreage is limited, occurring primarily along the coastal plains. Swains and Rose are low coralline atolls less than 10 m high. Swains is a small raised atoll enclosing a 259-acre (105 ha) central, brackish lagoon, including a 4-acre (1.61 ha) coastal marsh. Like Laysan, this water body functions more as a lake than a true lagoon. Rose is a USFWS wildlife refuge and the world's smallest atoll with 2 islets on a near circular reef. Rose Island is dominated by a *Pisonia* forest with a surrounding sandy beach, and the other, Sand Island, is a sandy islet. Combined, the two islets are 24.7 ac (0.1 km²) in size.

Shorebird habitat in American Samoa is limited, and this coupled with the remoteness of the island group has resulted in low species diversity and abundance of shorebirds. Habitats primarily utilized include beaches and rocky shorelines, enclosed lagoons, mudflats, littoral and mangrove forests, and to a lesser degree wetlands. As with other Pacific Islands, the Pacific Golden-Plover is the most numerous species utilizing a wide array of habitat including the ever-present lawns, grasslands and other open spaces associated with human development.

Wetlands and Enclosed Lagoons

American Samoa supports 495-wetland acres (200 ha): 350 ac (142 ha) on Tutuila, 112 ac (45 ha) on Aunu`u, 20 ac (8 ha) on Ta`u, and smaller sites are scattered on other islands. Only 100 acres (40 ha) of freshwater wetlands are found in American Samoa, and most are emergent stands of ferns (*Cyrtosorus interruptus* and *Acrostichum aureum*) and spike rush (*Eleocharis*). The majority of these acres are found on Nu`uuli Pala lagoon and the Aunu`u wetlands. Along river bottoms, swamps predominate with dense under story of ferns. Some ephemeral wetlands occur as well but to a lesser degree than in the Marianas and Hawai'i, a result of steep topography and small coastal plains. Overall these wetland habitats are not of primary importance for shorebirds, but some habitat restoration and management could improve conditions to expand their use by migrant birds.

Aquaculture is common in American Samoa with Taro being the predominate crop. In 1989, Taro covered 1,240 ac (495 ha) in American Samoa, mostly as small family farms and local commercial farms (Am. Samoa Comm. College web site 2002). Dry land taro comprises the predominate variety grown. Wetland taro is grown in limited acreage on Aunu`u and Ta`u. On these islands, fields are not flooded as in Hawai'i, but wet mud and fallow ground does support some shorebirds.

Closed lagoons on Swains and Aunu`u function as lakes. The shorelines of these lagoons are no doubt important to shorebirds, but little data are available to assess their conservation role or needs.

Beaches and Rocky Shorelines

Beaches are a physical feature of these eroded islands, and remain an important habitat for plovers, turnstones and, to a lesser degree, tattlers (Amerson, Jr. et al. 1982). There are approximately 21 miles (53 km) of coralline beaches in American Samoa, and many remain undeveloped. They are also important for nesting sea turtles. In particular, the beaches bordering lagoons at Rose and Swains are important wintering habitat for Bristle-thighed Curlews (Amerson, Jr. et al. 1982). Another important

habitat is rocky shoreline where most of American Samoa's Wandering Tattlers over-winter. The use, distribution, and actual numbers of shorebirds in these habitats remains unclear and better quantitative data is needed to address conservation needs. 44

The beaches and dunes of Rose and Swains atolls are known to support Bristle-thighed Curlews, but overall shorebird use on these remote islands is poorly known.

Estuaries, Mangroves, Littoral Forests, Flats

There are few estuaries in American Samoa and those that exist are small as a result of short, steep watersheds on the high islands. On Tutuila, Nu'uuli Pala Lagoon is an embayment with extensive mudflats near its upper end. Mangroves reach their eastern limit in American Samoa. Mangrove forests are found only on Tutuila and Aunu'u and are characterized by Red Mangrove, grasses and sedges. The largest mangrove forest remaining in American Samoa (100 acres [40 ha]) is also located at Nu'uuli Pala. Amerson, Jr. et al. (1982) recorded good numbers of plovers and tattlers in mangrove forests. Much of American Samoa's mangrove forests have been degraded or destroyed by humans. The Nu'uuli Pala forest contains a unique plant community that has all but been removed in American Samoa (Amerson, Jr. et al 1982). Protection of the remaining forests should be coupled with the need to protect surrounding wetlands and lagoon mudflats. Because American Samoa is Equatorial, there is little tidal variation so mudflats are not as extensive as is seen in more temperate latitudes. Smaller flats might be used for only short periods and thus may not be of primary importance for shorebirds. The flats of Nu'uuli Pala are the largest in the islands, thus providing one of the most significant shorebird habitats in the island group.

The Littoral Forests of American Samoa have been found to support a surprising number of shorebirds including plovers and tattlers (Amerson, Jr. et al.1982). This forest type has been mostly cleared by humans for rural development and settlements, and as a result has become a threatened habitat. As with mangroves, the clearing of this forest type may have had detrimental impacts to shorebird numbers, but the impact remains undocumented. Littoral forests are dominated by *Pandanus*, *Pisonia*, *Barrintonia*. The dominant tree depends on the substrate and soils. Protection of remaining littoral forests and possible reforestation is a conservation action important to shorebirds.

Grasslands of Importance to Shorebirds

As with other Pacific islands, ornamental grasslands, grazed areas, lawns, runway edges, and parks support Pacific Golden-Plovers. Village lands are of particular importance for plovers (Amerson, Jr. et al.1982). Habitat use in more upland sites is not reported peripherally used by plovers. Large pastoral lands as is seen in the Hawaiian Islands is lacking in American Samoa.

Shorebird Species

Although undoubtedly others have occurred, only seven species of shorebirds have been recorded in American Samoa (Appendix 2). The most common are Pacific Golden-Plover, Wandering Tattler, Ruddy Turnstone. Bristle-thighed Curlews are regular winter visitors on Rose and Swains Atolls, and has been recorded from Nu'uuli Pala Lagoon, Tutuila, and Aunu'u. The plover, tattler, and turnstone can be found in a variety of habitats. Amerson, Jr. et al. (1982) conducted an inventory and have provided the only estimates of these species in American Samoa. They estimated 4,500 Pacific Golden-Plovers, 900 Wandering Tattlers, and 550 Ruddy Turnstones. These numbers are small relative to USPI populations, except for Wandering Tattlers where the wintering populations, even at this coarse estimate represents 18% of the 5,000 birds wintering in the Pacific.

Regional Population and Habitat Goals

45

The population status of migrant shorebirds in American Samoa is poorly known. As with Hawai'i and the Marianas, common species wintering in the islands exploit a variety of habitats.

- ⇒ Determine the population size and trends of Bristle-thighed Curlew and identify critical habitats for long-term protection and monitoring
- ⇒ Identify the population size of Pacific Golden-Plover and identify critical habitats for long-term protection and monitoring
- ⇒ Determine, through banding studies, the breeding origin, migration routes and turnover rates for golden-plovers and Wandering Tattlers

Habitat Status, Threats and Management Needs

A major issue facing American Samoa's marine and coastal resources is non-point source pollution. Tutuila's coastal environments and coral reefs have shown degradation as a result of landfill contamination, oil spills, pesticide runoff, industrial waste, and incineration (USFWS 1996). Human sewage disposal and waste disposal from piggeries contaminate nearshore resources and estuaries, including Nu'uuli Pala Lagoon. In 1993, a commercial fishing vessel ran aground at Rose Atoll dumping over 100,000 gallons (378,500 liters) of diesel fuel and 2,500 lbs (1134 kg) of ammonia onto the reef causing widespread damage and lagoon (USFWS 1996). Although oil spills of this nature are not common in the Pacific Atolls, their one time occurrence can be catastrophic to the ecosystem.

The USFWS estimates that nearly 25% of historic wetlands have been lost in American Samoa. A higher percentage of Littoral and Mangrove forests have been lost (Amerson, Jr. et al. 1982). Most of the losses are the result of reclamation projects in conjunction with the development of Pago Pago Harbor and human settlements. Protection of remaining habitats on Nu'uuli Pala Lagoon and the Aunu'u wetlands is critical to conservation of wintering shorebirds in American Samoa. The primary issue of water quality needs to be addressed. Habitat restoration efforts could also be examined on Tutuila, Aunu'u, and the Manua Islands. The wetlands of American Samoa support two rare species, the Spotless Crake (*Porzana tabuensis*), rediscovered in the mid-1980s (Engbring and Engilis 1988) and the Pacific Black Duck (*Anas superciliosa*) rediscovered in the early 1990s (USFWS pers comm.). The only known populations of these two species exists on Ta'u Island. Conservation and recovery efforts for both would comprise of identifying wetlands for protection and those suitable for habitat restoration. Incorporating the needs of shorebirds into protection efforts must be carefully considered. The cultural importance of wetlands, both in maintaining the natural biota and cultivated wetland practices, need to be built into agencies efforts to conserving wetlands.

Introduced mammalian predators continue to hinder conservation efforts in American Samoa. The Polynesian Rat (*Rattus exulans*) has been eradicated from Rose Atoll, but still persists on Swains. Efforts to use rodenticids have met with opposition because of the lack of information on the potential impact of toxins on land crabs, an important food resource for humans (M. Naughton pers. comm.). Cats have been liberated on Swains to deal with the rat problem.

- ⇒ Protect existing wetlands, placing an emphasis on Nu'uuli Pala, Aunu'u, Swains and Rose lagoons
- ⇒ Develop understanding of restoration needs for wetlands that support shorebirds
- ⇒ Work with cultural farming to provide protection for wintering shorebirds utilizing aquaculture fields
- ⇒ Identify important remaining Littoral and Mangrove forests and seek for their protection
- ⇒ Restore Littoral and Mangrove forests where feasible
- ⇒ Eradicate all introduced mammals from Swains Atoll.

- ⇒ Establish a monitoring program for the early detection of introduced mammals on predator free islands
- ⇒ Develop response plan for quick eradication in the event introduced predators are detected

Monitoring Priorities

- ⇒ Develop and standardize an American Samoa biannual waterbird monitoring program inclusive of migrant shorebirds with initial emphasis on golden-plovers
- ⇒ Monitor shorebird response to habitat restoration sites to support adaptive management approach to wetland and tidal flat conservation
- ⇒ Monitor for contaminants and spills on beaches, wetlands, and tidal flats that are important for shorebirds. Work with local authorities to assess damage and outline restoration needs

Research Priorities

- ⇒ Assess species, abundance, population trends and habitat utilization of migratory shorebirds. Focus should be placed on Golden-Plover and Bristle-thighed Curlew
- ⇒ Determine if land crabs accumulate toxins harmful to themselves or humans when exposed directly or secondarily to rodenticids
- ⇒ Undertake studies to better assess habitat utilization by migrant shorebirds in American Samoa
- ⇒ Examine ecological factors of lagoon systems and identify limiting factors for shorebirds.
- ⇒ Develop habitat based GIS that examines critical shorebird habitats in concert with other environmental goals
- ⇒ Develop a strategy to enhance and create habitats that can be used by migrant waterbirds as well as by native waterbird species

Education Priorities

- ⇒ Managers should strive to educate developers, economic planners, and the public of the importance of coastal forest, wetlands, and beaches in maintaining the Samoan biota
- ⇒ Educate the public about migratory shorebirds
- ⇒ Develop education curricula studying shorebird migration (golden-plover), emphasize connectivity of American Samoa to Alaska, Siberia and Oceania
- ⇒ Involve schools and the public in monitoring program for golden-plover

Implementation and Coordination

Coordination with development and economic plans for expanding human development is needed. The USFWS has developed a multi-agency partnership with the Government of American Samoa to develop a coastal ecosystem restoration and enhancement program. Key to cooperative efforts is the improvement of information about wetlands, shorebird use as well as other native wetland dependent species. Protection of atolls is paramount not only for shorebirds but also breeding seabirds, turtles, and diverse coral reefs. Efforts have become established in American Samoa, such as the American Samoa Coastal Management Program coordinated by the Department of Marine and Wildlife Resources and American Samoa EPA. Incorporating the need to conserve shorebird resources, as part of the overall coastal conservation planning strategies is needed.

Central Pacific Islands Sub-region

Description of Sub-region: The Central Pacific Islands is a vast region of the Pacific where USPI possessions are scattered across an 850,000- mi² (1.575 million km²) region of the Central Pacific, encompassing the islands of Wake, Johnston, Howland and Baker (Phoenix), Jarvis, Kingman Reef, and Palmyra (Line) (Fig. 1). Human habitation is restricted to military installations on Wake and Johnston. Land area of these islands, combined, is only 17.8 mi² (33.4 km²) (Table 7). The U. S. Fish and Wildlife Service manages Howland, Baker, Jarvis, Kingman Reef and Johnston atolls as part of the Pacific Remote Islands National Wildlife Refuge Complex. The Nature Conservancy owns and manages the main island at Palmyra and the lagoon and surrounding reefs are part of the Remote Islands National Wildlife Refuge. The USFWS is working with TNC to get the lesser islands of Palmyra into the refuge system.

Table 7. Characteristics of Primary Islands in Central Pacific Islands Subregion

| Island | Size | Max Elevation | Characteristics |
|----------|----------------------|---------------|--|
| Howland | 1.6 km ² | 3m | coral island herbaceous and shrub vegetation |
| Baker | 1.4 km ² | 8m | coral island herbaceous and shrub vegetation |
| Jarvis | 6.7 km ² | 7m | sandy coral island w/ fringe reef |
| Johnston | 2.8 km ² | 5m | 2 islets, 2 man made islands |
| Kingman | | 1m | triangular atoll-like reef, no appreciable island |
| Palmyra | 11.9 km ² | 2m | 50 islets, surrounding two lagoons, <i>Pisonia</i> and Coconut forests and herbaceous vegetation |
| Wake | 9.0 km ² | 7m | 3 islets on atoll, forests, shrubs, and herbaceous cover |

Source: www.doi.gov/oia/facts 2000 and www.cia.gov/cia/publications/factbook.

Wetlands of Importance to shorebirds

There are no wetlands in this subunit

Beaches of Importance to Shorebirds

An important resource for shorebirds, particularly Bristle-thighed Curlew, turnstones and golden-plovers, particularly on uninhabited islands. Most of these islands are so small that they function as beach strands with associated dunes. Only Palmyra has dense Littoral *Pisonia* Forests which are utilized by shorebirds (as is seen in American Samoa). Wake supports shrublands and some forested habitat.

Margins of Lagoons

Lagoons are a common feature in this sub-region and their margins offer habitat for migrant shorebirds, particularly curlews and golden-plovers. Those of noted importance for shorebirds include the lagoon margins on Palmyra and Wake.

Shorebird Species

Thirty-five species of shorebirds have been recorded in this sub-region. The sub-region is of primary importance for Bristle-thighed Curlew and Pacific Golden-Plover. Other species occurring in regular numbers include Ruddy Turnstone, Sanderling, Wandering Tattler, Gray-tailed Tattler, and Bar-tailed Godwit. There are no estimates of numbers for Pacific Golden-Plover or other shorebirds found in the Central Pacific Islands because these islands are extremely isolated and visits are irregular. More than 200 Bristle-thighed Curlews have been recorded from the lagoons of Palmyra (USFWS) and fewer than 50 birds from Howland and Baker (Marks and Redmond 1994). Eleven curlews were counted on Johnston Island during the 1999 Christmas Count conducted by the USFWS (NAS 2000, 2001). Still, the wintering population of Bristle-thighed Curlews in the Central Pacific Islands remains virtually unknown, but from the limited data from this region, it is clear that these islands provide important habitat for this species. The Tuamotu Sandpiper has not been recorded from the USPI in this region, but the type specimen was collected from Kirimati Island, in the Line Islands. Palmyra and Jarvis are located in the Line Islands and could offer locations for possible recovery efforts.

Regional Population and Habitat Goals

The population status of migrant shorebirds in the Central Pacific Islands is unknown. Understanding habitat use by shorebirds in the region needs to be clarified; particularly the status and distribution of Bristle-thighed Curlew.

- ⇒ Determine the population size and trends of Bristle-thighed Curlew and identify critical habitats for long-term protection and monitoring
- ⇒ Assess populations of other regularly wintering species of shorebirds
- ⇒ Develop population objectives for Bristle-thighed Curlews once current levels are understood

Habitat Status, Threats and Management Needs

As with other sub-regions covered in this plan, common species wintering in the islands exploit a variety of habitats. Pacific Golden-Plover winters in close association with humans on lawns, tarmacs of military fields, and on rooftops and also beaches, wetlands and other natural habitats. Habitat priorities are to protect existing upland and beach habitats important to shorebirds on developed islands, and placing an emphasis on protection of the principal beaches and lagoon edges that support wintering Bristle-thighed Curlews (e.g. Wake, Palmyra, and others). Several islands in this sub-region are uninhabited. However, the perturbations that have occurred are unparalleled. Many of the atolls provided strategic positions for the U. S. during WWII and through post-war efforts. Nuclear tests, military dumping and munitions storage remains a concern particularly on Johnston and Wake islands. Groundwater and nearshore pollution from these storage facilities is suspected but not documented. Daily sewage discharges are regular occurrence on Johnston and Wake Islands, despite modernization of facilities in the early 1990s (USFWS 1996). Sources of contamination on Howland and Baker have been linked to WWII and post-war military activities. Chemical and nuclear munitions have been stored at Johnston Atoll, some leakage has occurred. These munitions at Johnston are currently being destroyed and cleanup is underway. Ground contamination by Dioxins is high in places, and three aborted thermonuclear warheads resulted in plutonium contamination of the entire atoll (USFWS 1996). The major issue facing marine and lagoon resources is non-point source pollution.

Introduced predators have been eradicated from all islands in this subregion except for Wake and Palmyra. Eradication efforts are currently underway in Palmyra. Wake remains a high priority.

- ⇒ Eliminate pollution sources from island base resources
- ⇒ Maintain clean beaches
- ⇒ Remove introduced mammals from islands Wake and Palmyra
- ⇒ Maintain islands as mammalian free

Monitoring Priorities

Monitoring priorities are similar to those in American Samoa. The main problem we face with shorebird conservation in this subregion is our lack of knowledge about their numbers, habitat use, threats, etc.

- ⇒ Develop a monitoring program to assess species, abundance, population trends and habitat utilization of migratory shorebirds. Focus should be placed on golden-plover and Bristle-thighed Curlew
- ⇒ Monitor for contaminants and spills on beaches, wetlands, and tidal flats that are important for shorebirds
- ⇒ Monitor the response of curlew to predator eradication on Wake and Palmyra

Research Priorities

- ⇒ Develop base understanding of the ecology of the Tuamotu Sandpiper in Polynesia and determine if suitable habitat exists in the Line Islands for establishing Tuamotu Sandpiper
- ⇒ Study the ecology of Bristle-thighed Curlew on low and coral islands and atolls with emphasis on Palmyra

Education Priorities

- ⇒ Education of USDOD Personnel on shorebird ecology, threats (predators and disturbance) and important habitats: beaches, dunes, and lagoons
- ⇒ Work with The Nature Conservancy to develop an education and outreach program regarding shorebirds, their ecology, and importance of predator free islands

Implementation and Coordination

Johnston, Howland, Baker, Jarvis, Palmyra, and Kingman Reef are in the Pacific Remote Islands NWR Complex. Johnston and Wake are military installations. Various islets in Palmyra Atoll are owned by USFWS and The Nature Conservancy. Efforts to clean contaminated sites are being addressed by the USFWS and USDOD. Removal of rats and cats is a priority for nesting seabirds as well as wintering shorebirds.

Tuamotu sandpiper (*Prosobonia cancellata*)



Photo: Courtesy of C. Blanvillain
(Ornith. Soc. of Polynesia)

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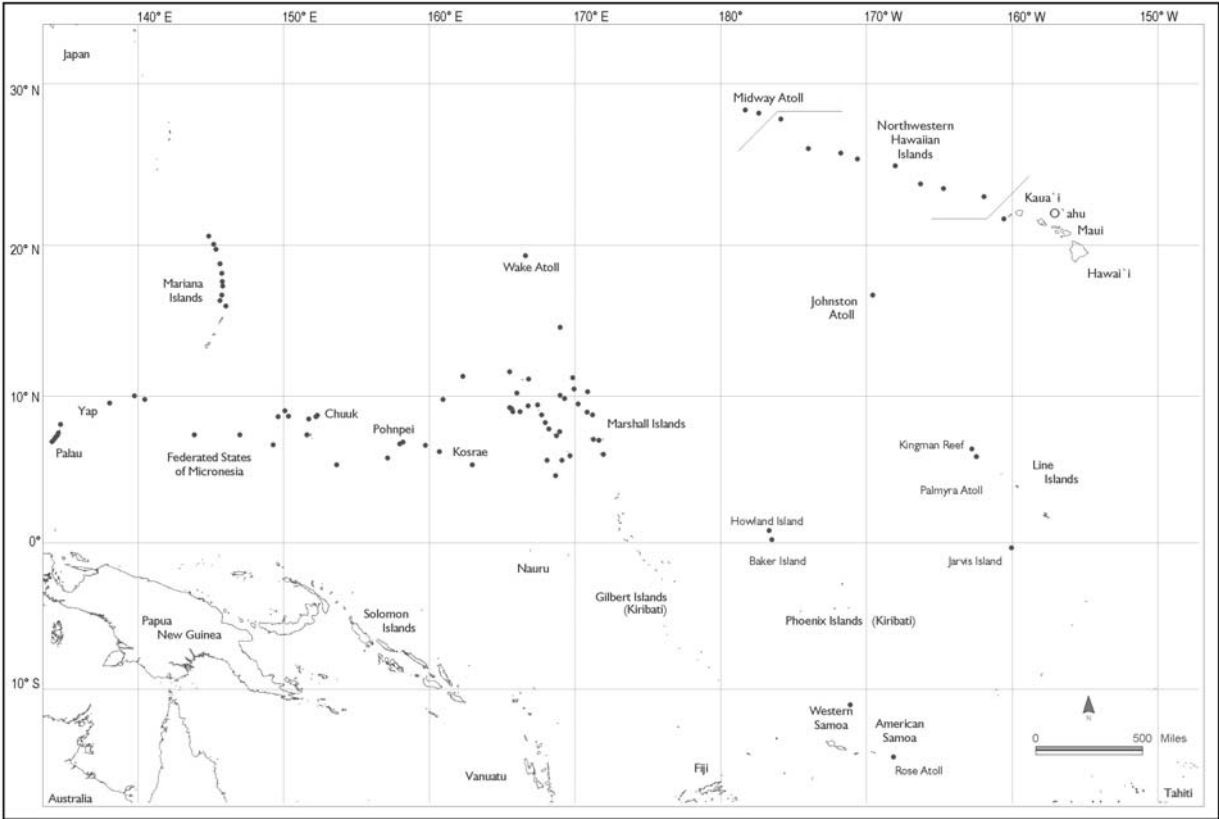
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Figure 1: U. S. Pacific Islands Map



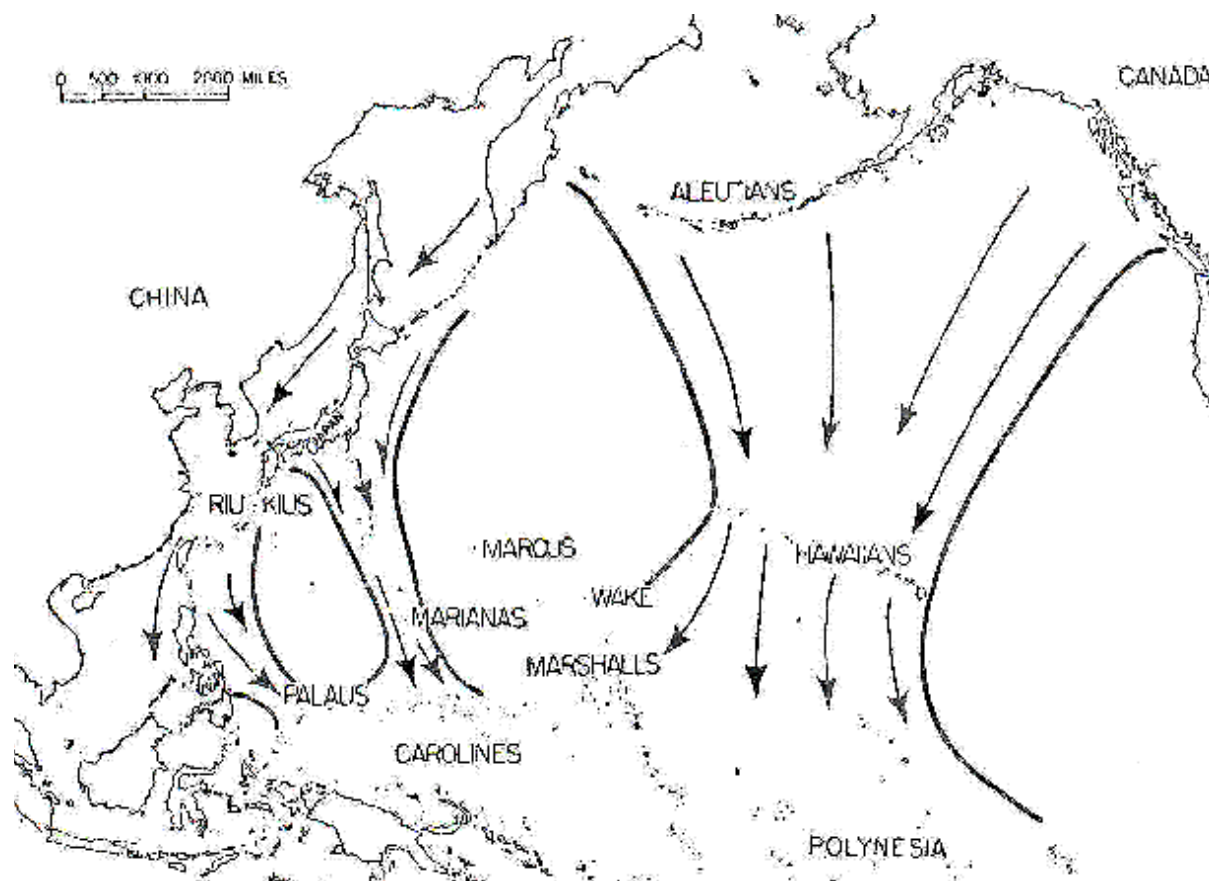


Figure 2. Routes of migration used by shorebirds in the Pacific Ocean (reprinted from Baker 1953).

Figure 3. Hawaiian Islands Map

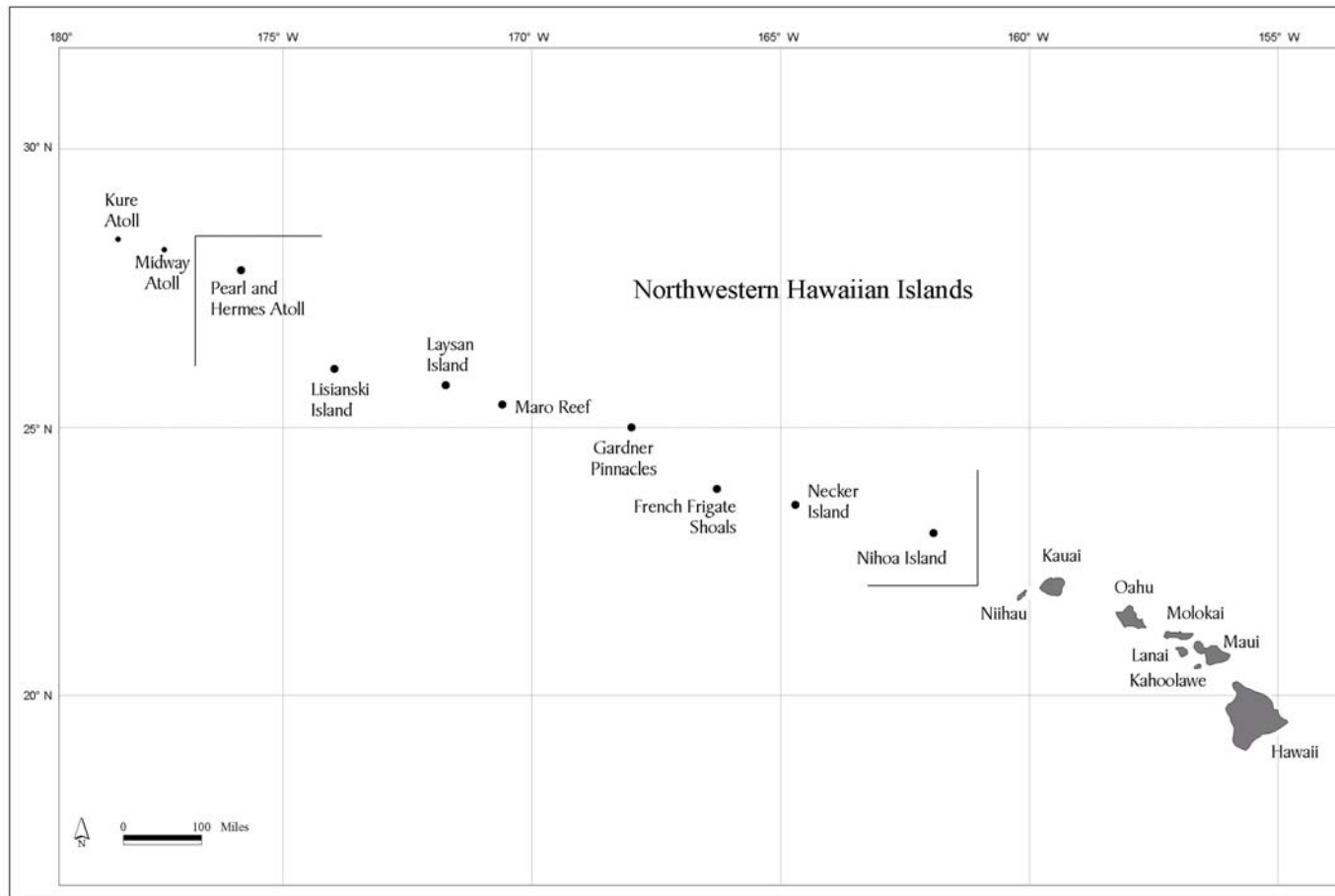


Figure 10. Mariana Islands Map

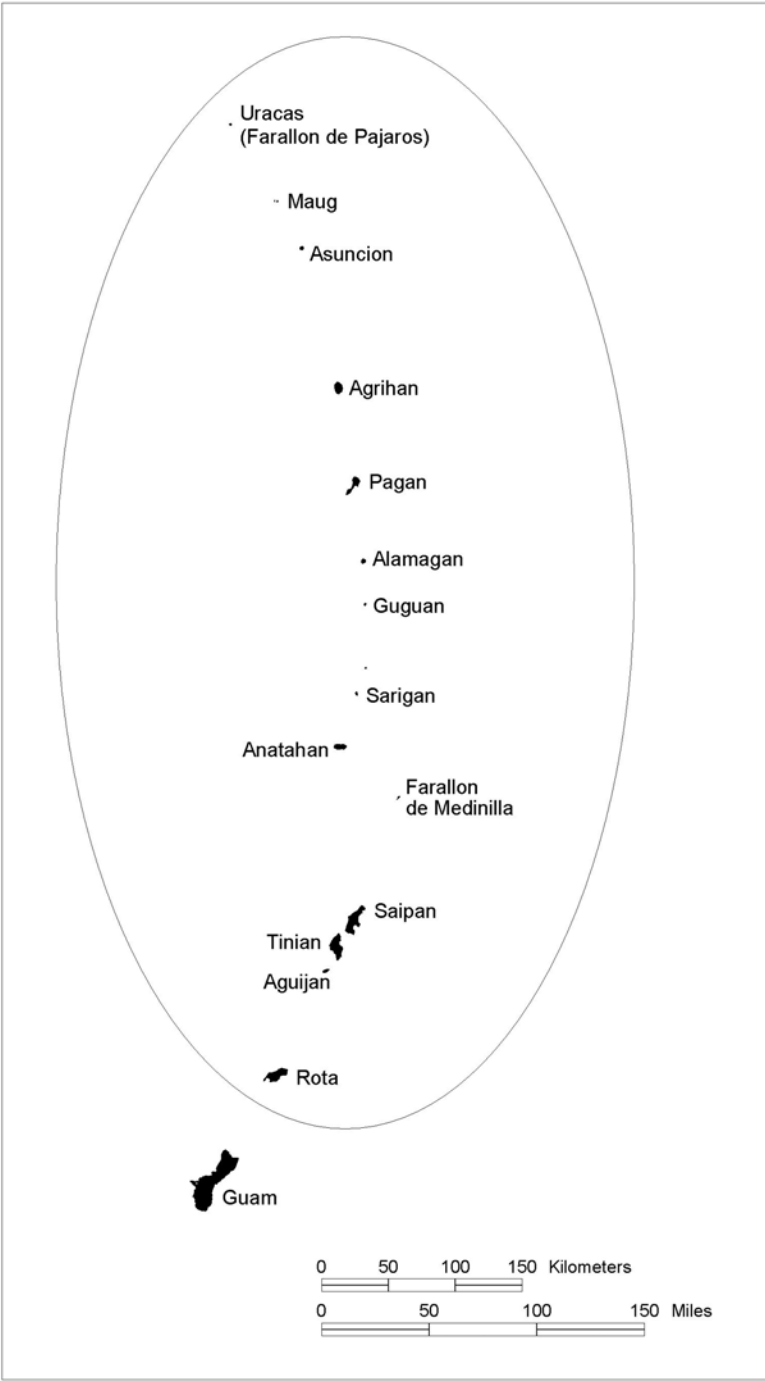
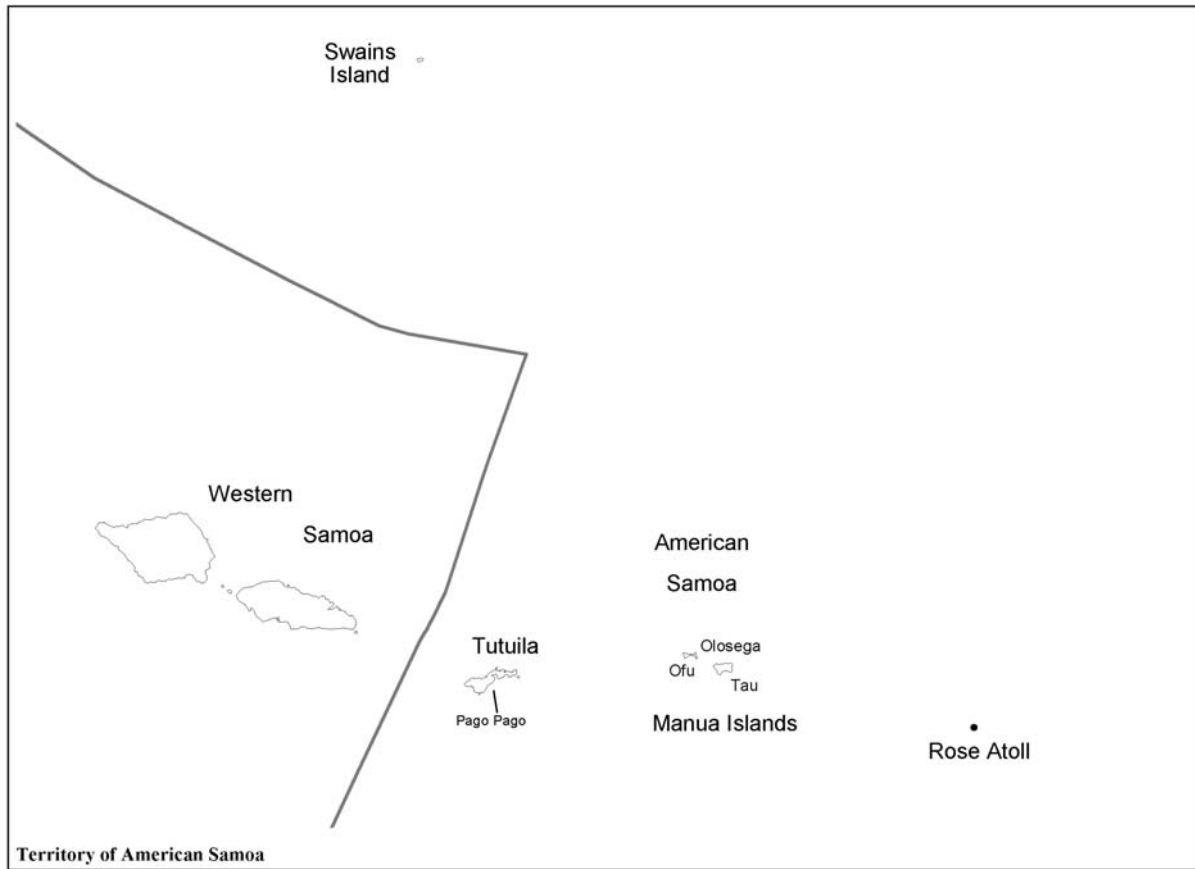


Figure 11. American Samoa Map.



Appendix 1. List of all islands in the USPI and covered by this plan.

Hawai`i – State

Main Islands

Hawai`i
Maui
Kaho`olawe
Lana`i
Moloka`i
O`ahu
Kaua`i
Ni`ihau
Kaula

Northwestern Hawaiian Islands

Nihoa
Necker
French Frigate Shoals
Gardner Pinnacles
Laysan
Lisianski
Pearl and Hermes Reef
Kure
Midway Atoll – (unincorporated insular area)

Commonwealth of the Northern Mariana Islands – covenant of “political union”

Rota
Aguijan
Tinian
Saipan
Farallon de Medinilla
Anatahan
Sarigan
Guguan
Alamagan
Pagan
Agrihan
Asuncion
Maug
Uracas

Guam - Territory

American Samoa - Territory

Tutuila
Aunu'u
Ofu
Olosega
Ta'u
Rose
Swains

Palmyra (in Line Islands) – Territory

Kingman Reef (in Line Islands) - Possession

Jarvis (in Line Islands) - Possession

Howland (in Phoenix Islands) - Possession

Baker (in Phoenix Islands) - Possession

Johnston– Territory

Wake - Territory

Appendix 2. Status and Regional Occurrence of Shorebirds in the U. S. Pacific Islands

List of Species occurring in U.S. Pacific Islands- Where USPI are of minor importance to populations.
Conservation actions will have little impact on overall species population levels.

| Species | Status | Population Trends In Pacific Islands | Importance of Pacific Islands to NA Population |
|-----------------------|----------------|---|--|
| Black-bellied Plover | Winter Visitor | Unknown | Low numbers annually, little importance |
| Semipalmated Plover | Transient | Unknown | Low numbers annually, little importance |
| Lesser Yellowlegs | Transient | Unknown | Low numbers annually, little importance |
| Bar-tailed Godwit | Transient | Unknown | Low numbers annually, little importance |
| Western Sandpiper | Winter Visitor | Unknown | Low numbers annually, little importance |
| Least Sandpiper | Winter Visitor | Unknown | Low numbers annually, little importance |
| Pectoral Sandpiper | Transient | Unknown | Low numbers annually, little importance |
| Dunlin | Winter Visitor | Unknown | Low numbers annually, little importance |
| Long-billed Dowitcher | Winter Visitor | Unknown | Low numbers annually, little importance |
| Common Snipe | Winter Visitor | Unknown | Low numbers annually, little importance |
| Wilson's Phalarope | Transient | Unknown | Low numbers annually, little importance |

Appendix 2 -- continued.

List of Species occurring in USPI – Where U. S. islands Western Pacific including Marianas) are important to species breeding in Asia and wintering in Pacific Islands.

| Species | Status | Population Trends In Pacific Islands | Importance of Pacific Islands to NA Population |
|------------------------|----------------|---|---|
| Gray-tailed Tattler | Winter Visitor | Unknown | Important as Primary Wintering Area, Western Pacific |
| Sharp-tailed Sandpiper | Transient | Unknown | Minor importance as winter and migration habitat |
| Ruff | Transient | Unknown | Minor importance as winter and migration habitat |
| East Asian Whimbrel | Winter Visitor | Unknown | Minor importance as winter and migration habitat |
| Mongolian Plover | Winter Visitor | Unknown | Minor importance as winter and migration habitat |
| Rufous-necked Stint | Winter Visitor | Unknown | Minor importance as winter and migration habitat |
| Wood Sandpiper | Winter Visitor | Unknown | Minor importance as winter and migration habitat |

Migratory Shorebird Species List – U. S. Pacific Islands Nearctic Breeding Species

| Species | Hawaiian Islands | Mariana Islands | Central Pacific Islands | American Samoa |
|-------------------------|---------------------|--------------------|----------------------------|-------------------|
| Semipalmated Plover | X | | | |
| Killdeer | X | | | |
| Greater Yellowlegs | X | X | X | |
| Lesser Yellowlegs | X | | X | |
| Solitary Sandpiper | X | | | |
| Willet | X | | | |
| Wandering Tattler | X | X | X | X |
| Spotted Sandpiper | X | | X | |
| Bristle-thighed Curlew | X | X | X | X |
| Hudsonian Godwit | X | | X | |
| Marbled Godwit | X | | | |
| Semipalmated Sandpiper | X | | | |
| Western Sandpiper | X | | | |
| Least Sandpiper | X | | | |
| Baird's Sandpiper | X | | | |
| Pectoral Sandpiper | X | X | X | |
| Buff-breasted Sandpiper | X | | X | |
| Stilt Sandpiper | X | | | |
| Short-billed Dowitcher | X | | | |
| Wilson's Phalarope | X | | | |

Appendix 2. Cont.. Regional Importance and Occurrence of Shorebirds in the U. S. Pacific Islands

Migratory Shorebird Species List – U. S. Pacific Islands
Palearctic Breeding Species

| Species | Hawaiian Islands | Mariana Islands | Central Pacific Islands | American Samoa |
|---------------------------|------------------|-----------------|-------------------------|----------------|
| Mongolian Plover | X | X | X | |
| Greater Sand-Plover | X | X | X | |
| Common Ringed Plover | X | X | X | |
| Little Ringed Plover | | X | X | |
| Oriental Plover | | | X | |
| Eurasian Dotterel | X | | | |
| Eurasian Oystercatcher | | X | | |
| Black-winged Stilt | | X | X | |
| Common Greenshank | | X | X | |
| Marsh Sandpiper | | X | X | |
| Spotted Redshank | | X | X | |
| Nordmann's Greenshank | | X | | |
| Green Sandpiper | | X | X | |
| Wood Sandpiper | X | X | X | |
| Grey-tailed Tattler | X | X | X | |
| Common Sandpiper | X | X | X | |
| Terek Sandpiper | | X | X | |
| Little Curlew | | X | X | |
| Far Eastern Curlew | X | X | X | |
| Eurasian Curlew | | X | | |
| Black-tailed Godwit | X | X | | |
| Great Knot | | X | X | |
| Little Stint | X | X | | |
| Red-necked Stint | X | X | X | |
| Temminck's Stint | | X | X | |
| Long-toed Stint | X | X | X | |
| Sharp-tailed Sandpiper | X | X | X | |
| Curlew Sandpiper | X | X | X | |
| Broad-billed Sandpiper | | | X | |
| Ruff | X | X | X | |
| Pin-tailed Snipe | X | X | X | |
| Japanese (Latham's) Snipe | | X | | |
| Swinhoe's Snipe | | X | X | |

Appendix 2 -- continued.

Migratory Shorebird Species List – U. S. Pacific Islands
Circumpolar, Holarctic Breeders (Asia and NA)

| Species | Hawaiian Islands | Mariana Islands | Central Pacific Islands | American Samoa |
|-----------------------|------------------|-----------------|-------------------------|----------------|
| Pacific Golden-Plover | X | X | X | X |
| Black-bellied Plover | X | X | | |
| Snowy Plover | | X | X | |
| Whimbrel | X | X | | X |
| Bar-tailed Godwit | X | X | | X |
| Ruddy Turnstone | X | X | | X |
| Red Knot | X | | | |
| Sanderling | X | X | | X |
| Dunlin | X | X | | |
| Long-billed Dowitcher | X | | | |
| Common Snipe | X | X | | |
| Red-necked Phalarope | X | | | |
| Red Phalarope | X | | | |

References for Appendix 2: (Pyle 1997, Pyle and Engbring 1985, Reichel and Glass 1991, Pratt et al. 1987).

Pacific Island Shorebird Habitats:



Pacific Atolls, Johnston
(above), Palmyra (upper
right), and Rose (right)



Photos Courtesy of USFWS



Beach and lagoon habitats, Midway Atoll,
Hawaiian Islands.



Photos Courtesy of A. Engilis, Jr.

Pacific Island Shorebird Habitats: Lowland Saline Marshes and Ephemeral Playas



Photos Courtesy of USFWS

Kealia Pond, Maui, near empty (Fall, above) and full (winter, right).

Below: Kealia Pond in fall with water levels ideal for migrant shorebirds. Photos courtesy USFWS.



Pacific Island Shorebird Habitats: Semi-permanent/Permanent Wetlands.



Opae'ula Pond (above),
and anchialine ponds
(left), Island of Hawai'i.
and unnamed wetland in
American Samoa

Upper two Photos Courtesy of: A. Engilis, Jr.



Photo Courtesy of USFWS

Pacific Island Shorebird Habitats: Freshwater Ephemeral Wetlands



Photos Courtesy of: A. Engilis, Jr.

Ephemeral freshwater wetlands on Guam. Farmed wetland with overgrown wetland in near foreground (above). Unfarmed wetland Basin (right). Hawaiian Stilt and Ruffs in seasonal wetland Kahuku, O'ahu, Hawaiian Islands.



Pacific Island Shorebird Habitats: Artificial Freshwater Habitats



Managed wetland unit,
Hanalei NWR, Kaua'i,
Hawaiian Islands.

Photos Courtesy of: A. Engilis,

Chevron refinery ponds, stilt
nesting site, O'ahu, Hawaiian
Islands.



Managed stilt breeding habitat,
also supports migrant
shorebirds, Kona Coast, Island
of Hawai'i.

Lotus fields depicting excellent
foraging conditions for shorebirds,
Waialua, O'ahu, Hawaiian Islands.



Pacific Island Shorebird Habitats: Grasslands and Parks



Photos Courtesy of A. Engilis, Jr.

Grazed Uplands, Kehena District,
Island of Hawai'i.



Golf Course, Maui, Hawai'i,
Photo Courtesy Hawai'i Department of Tourism

Kapiolani Park, O'ahu, Hawai'i

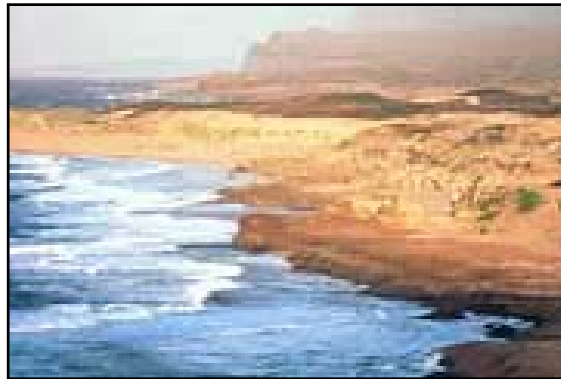


Photo Courtesy Hawai'i Department of Tourism

Pacific Island Shorebird Habitats: Beach, Dune and Off Shore Islets



Manana and Bird islands, offshore of windward coast of O'ahu



Moomomi Dunes Preserve, Moloka'i



Kailua Beach Park, O'ahu, Hawaii

Pacific Island Shorebird Habitats: Estuarine



Tidal Flats, Pearl Harbor, Hawaiian Islands

